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The Day of the Engineer

WHEN this issue reaches its readers many of the members of the International Engineering Congress will be on their way to the Coast, since most of them will have planned to attend the society conventions held during the previous week. It is to be hoped that the delegations will be very large, for seldom has it been given engineers to participate in a more momentous occasion. Deprived by the war of the thrilling ceremony that was planned at the Canal itself, the great work must rest for its inaugural with the splendors that San Francisco has piled up alongside the Golden Gate. Since February the world by its participation in the exposition has been giving testimony to its appreciation of what has been wrought in Panama. But the next two weeks mark in reality the climax of the celebration, for those who have made the canal—the engineers—and thus given warrant for the exposition will gather at San Francisco to bear their part in testifying to the mightiness of the achievement. In a subtle way the ten-months-long celebration in San Francisco has been America's proclamation of its pride in its engineers, and cold indeed must be the member of the profession who will not thrill with the significance of the occasion when the International Engineering Congress opens a week from Monday. The program befits the occasion. For its complete success there is needed only a large and enthusiastic attendance.

Panama Canal's First Year

ANNOUNCEMENT was made in the Engineering Record of Aug. 28, page 251, of the tonnage moved through the Panama Canal during its first fiscal year, ended June 30. This fiscal year was only 10½ months, however, as regular service did not begin until Aug. 14. The full calendar year is now reported in the *Canal Record.* The canal was used by 1317 ocean-going vessels, carrying a gross tonnage of 6,494,673 tons and a net tonnage of 4,596,644 tons. The net toll collections for the year aggregated $5,102,063.37. The movement and tonnage was about 25 per cent of that of the Suez Canal during 1914. As the receipts for the new ditch in July, 1915, were more than double those of September, 1914, and 50 per cent more than those of December, January or February, the growth in traffic may be expected to continue, and it may not be long before the new ditch rivals the old.

South Philadelphia Improvement

LAST April actual construction work was begun on one of those widespread urban improvements which, because of the number of beneficiaries, and the number and complexity of the advantages to be obtained and concessions to be made, never get to the construction stage except after years of conference and compromise. The improvement referred to is that at South Philadelphia, outlined on page 327. For $24,000,000 the parties to the project acquire advantages that can hardly be estimated—far more valuable, certainly, than any of them could obtain by spending money independently. A popular error would be to suppose that the work for the engineer has just begun, and that the negotiations that have gone before belonged to the politicians, the trade organizations and the business men and manufacturers. This is far from the truth. Feasibility, efficiency and cost are all points to be considered with regard to each change proposed, and all can best be rated by the man technically trained. This is city planning, and it deserves more recognition, both by the engineers who might be doing it, and the general public, whose appreciation is necessary before it can bring material results. In the South Philadelphia work, the engineers, through the city's Bureau of Surveys and the railroads' engineering departments, played a material part in the preliminary studies.

Straws in the Wind

SURPRISING indeed has been the interest in the use of a mortar bed for brick pavements since the Engineering Record on July 10 published Mr. Blackburn's article describing the road built under his advice and that of Mr. Parrish at Paris, Ill. This pavement, it will be remembered, was all—base, cushion and brick—laid at one time, securing a monolith from sub-base to top. As a result of the publicity given to this type of construction, the Illinois town has recently been a Mecca for highway engineers. Some time ago a party numbering twenty-seven came up from St. Louis in a special car to see it, and found on the road at the time seven other inspection parties. Certainly this is a straw showing how thought on pavement construction is tending. And well may the Paris type be given most serious consideration. If the explanation vouchsafed by Mont Schuyler of St. Louis, be accepted, that breaking down of brick pavements is due to local hollow spots left by the shrinking of the sand—and if the danger of shifting cushion be conceded, the use of the mortar cushion is in the present state of the art the only alternative. But beyond this the immediate laying of cushion and brick on the wet base gives an element of strength, through the monolithic action of the deep slab, that is absent in the ordinary type, and even in that where a mortar cushion is used but is placed after the base has set. Furthermore, the securing of a monolith should permit the reduction of the thickness of the base or of the brick or both. This journal believes that a much smaller total thickness, using this type of construction, will give results equal to those obtained with the customary 6-in. base and 4-in. block, using a sand cushion. If the brick thickness be reduced, freight charges will be lessened and this type may thus be in a better position to compete with the thicker concrete road. When Mr. Blackburn's article was published this journal expressed the opinion that the Paris example would surely be followed elsewhere. In view of the extent to which the road is being inspected that prediction can safely be repeated with decided emphasis.

Inland Water Transportation

JUDGED by the success of river transportation abroad one would feel justified, offhand, in predicting a big future for conveying bulk shipments by water in this country. On careful consideration, however, one must evaluate several factors which must make the development conditional. The railroads have robbed the Mississippi, in particular, of its former large traffic. Whether under better river conditions—an improved type of barge and good terminal facilities—the railroad will still be able to dominate remains to be seen. Theoretically the advantage is all in favor of river transportation, when the freight is of a bulky nature. Nevertheless, one cannot feel that the trade on the Mississippi would have slumped so badly, by comparison with the traffic of the railroads, had the argument been entirely one-sided. Few men in this country, however, are better qualified to champion water transportation than Capt. John H. Bernhard, and his extremely readable 48-page discussion of the subject in the "Proceedings" of the American Society of Civil Engineers is bristling with arguments that are not easily answered. He also gives much interesting information about the barge trip he made up the Mississippi and back a year ago, and about the line of barges which a company organized by him proposes to put into service between New Orleans and St. Louis. Considerable space, therefore, beginning on page 332 of this issue, is given to an abstract of his discussion, and even then it is possible only to skim over many points he treats at length. On the question of rates, while the Engineering Record believes within certain limits in the doctrine "Charge what the traffic will stand," on the ground that where much profit is not possible it is justifiable to get a little and even up to some extent elsewhere, it, of course, deplores hauling goods below cost to starve out water competitors, or for any other reason; and apparently the widely variable rates quoted by Captain Bernhard would bear investigation. As to terminals and their effect on time and cost of transportation, it is perhaps worth noting that while river terminals are crude in the extreme, rail terminals also are susceptible of improvement that would make for cheaper and faster transit, and that although the railroads do now fail to move a freight car a daily average of anything like 72 miles, the figure is not unbelievably high for the future. It is not the purpose here, however, to concur with or dispute Captain Bernhard's arguments in detail, but to present them as fairly and completely as possible in the limited space available, trusting that his paper will stimulate interest in the subject and draw discussion from well informed proponents on both sides.

The Algae Problem

SURFACE water supplies stored in reservoirs are apt to become foul at this season of the year because of the growth of microscopic plants known collectively as "algae." Warm water, sunlight, plenty of food supply in the form of carbonic acid, oxygen, nitrates and organic matter contribute to their growth. Currents of the water, both horizontal and vertical, are also vital factors. These and a few other things have been learned about algae during the forty years since the study of these organisms was begun in Massachusetts by Dr. W. G. Farlow of Harvard University and Prof. William Ripley Nichols of the Massachusetts Institute of Technology. But, after all, are we not a long way from knowing what every waterworks man wants to know—why the growths appear in one reservoir and not in another? why one year and not the next? how their growth may be anticipated and checked? So many different factors are involved that, as Hazen and Whipple have recently pointed out, their occurrence in reservoirs seems to follow the well-known laws of probability, or chance.

Considerable progress has been made in methods of destroying algae by the use of chemicals, and of removing them and the odors which they produce by aeration and filtration, but the fundamental biological problem still remains unsolved, and it is too important a problem to be passed over as it has been passed over in recent years. The discussion as to the benefits of soil stripping—that is, the removing of soil rich in organic matter from the bottoms of newly built reservoirs—still continues and is likely to continue until some of the fundamental reasons for the growth of algae have been better established. Engineers need the further assistance of well-trained biologists. Of late years the subject has been considered almost exclusively along practical lines. What is needed now is more theory, more pure science.

One reason, doubtless, why progress has been slow, is that the microscopic organisms have been considered together as a group, the one thing in common being that they are small. As a matter of fact they differ most widely. Some are animals, some are plants; some are heavy, some are light; some are attracted by light, and light repels others; some have chlorophyl, some do not. In all sorts of ways they differ. It would appear that what is now needed is concentration of study. Let some one confine his study to Anabaena, let us say, and he will find work enough for several years. Another need is field work. The continued counting of the number of organisms in samples of water sent to the laboratory will never lead to a discovery of the laws of their growth, because their life history may include phenomena which take place along the shores or on the bottom of a reservoir as well as in the water itself. A closer study of the subsurface topography of reservoirs is needed, a study of the relation of bottom area to volume, and particularly a study of the bottom area exposed to the circulating waters as contrasted with that in contact with stagnant water. Yet along with this concentrated study must go its complement, the study of the inter-relations between different classes of organisms.

In Europe the science of limnology has been pursued to greater lengths than in this country. Fifteen years ago the American Limnological Commission was organized, but after a feeble existence it died through lack of proper support. It is time that a new limnological commission was created and that the algae problem was taken up by new minds, and in new ways, with the hope of a better understanding of the subject. Such a study, to yield results, must be extended in time and space, and that would involve an expense of several thousand dollars annually. But to remove the soil from a large reservoir may cost hundreds of thousands of dollars. For a reservoir like the Ashokan of the Catskill supply for New York City it would have been a matter of several million dollars. The poisoning of algae with copper sulphate is an unsatisfactory and, at best, only a palliative process, while the filtration of algae-laden water introduces problems not otherwise encountered. In these days of preventive medicine, engineers ought not to be content to use methods of cure. Surely the algae problem is worth studying anew.

The Militia Engineers

OF the different branches of the army, the engineer corps probably receives the least attention from the public, although it has done splendid work in Panama, Cuba, the Philippines, and in our own river and harbor work. Even the importance of the engineer in the present European war has not directed general interest toward the work of the army engineer. This is even more the case in respect to the engineer corps of the National Guard, many engineers not even knowing that such a corps exists. It is numerically small, and the companies are widely scattered, many States having no engineer companies at all, and few States having more than one. These conditions increase the difficulties of developing and training the organizations, and it is seldom that several companies can be brought together for drill.

The description on page 314 of the work of the engineer companies of the militia this summer at their camp near Washington shows the opportunity that the militia offers engineers for practical work in National defense. The work in camp covers a wide range and is as thorough and complete as the time permits. It is of value not only to the Government in training a body of engineers for active service, but to the men as well, in health and in lessons that apply to their civilian occupations. The mobilization of several engineer companies at once is invaluable, because it schools the officers in handling larger bodies of men, permits of work on a bigger scale and introduces a friendly rivalry between companies.

In the past the engineer companies of the National Guard have struggled along in obscurity, with little support from the States or the Federal Government, and even less from the engineering profession. As a result there is but one company in many places where there should be several, while cities well able to recruit one or more companies have none. Chicago, the engineering center of the Middle West, has but one company, and that is only three years old. It has been growing rapidly, however, and with the co-operation of the engineering profession, which now seems assured, should develop into a battalion. New York has but one. Pittsburgh, Boston, St. Louis, Detroit and many other large cities have none. An opportunity exists in all these places for engineers to prove their patriotism and to prepare to place their ability, training and knowledge at the disposal of the country.

Engineers and the Constitutional Convention

NOW that the work of the New York State Constitutional Convention is drawing to a close, it is fitting to estimate what has been accomplished by the committee of engineers which suggested certain plans to the convention. Constitutional revision on a wholesale scale is possible in New York only every twenty years. The committee of engineers was formed, therefore, to bring to the attention of the convention the advisability of certain changes involving engineering matters.

Officially there were represented on the committee the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the New York Section of the American Institute of Mining Engineers, the American Institute of Consulting Engineers, the Municipal Engineers of the City of New York and the Brooklyn Engineers' Club. Through participation of some of their members in subcommittee work several other societies were indirectly represented. The Rochester Engineering Society studied the matter independently and its recommendations to the convention closely paralleled those of the committee.

The chief recommendations were:

1. That all engineering functions of the State—the design, construction and operation of canals, highways, water conserva-

tion works, parks and public buildings—be placed under a State department of engineering and public works, with a commission of three members in charge, one member being an engineer.

2. That there be a single public service commission, composed of five members, at least two of them being engineers.

3. That one-third of the membership of the Court of Claims be made up of engineers.

Of these recommendations, only the first was, in any measure, adopted. Canals, highways and public buildings are to be consolidated under the Department of Public Works. Conservation is to be handled by a large non-salaried commission. A single head will control the Department of Public Works. There will be—if, of course, the people accept the new constitution, which seems likely—two public service commissions as in the past, while there will be no opportunity for the appointment of engineers to the Court of Claims.

Thus, there has been but meager accomplishment. It can be accounted for in various ways. Weighing most strongly against the suggestions of the committee was the fact that they ran counter to the spoils system—and the convention was run by the politicians. In the second place, much of the detail presented by the committee was believed by the delegates to the convention to be valuable, but to have a place rather in the statutes than in the constitution. This the committee realized when it framed the recommendations. The details were included, however, so that if the convention departed from making provisions for only the broad outlines, the views of the engineers would be advanced.

Finally, for success in matters of this kind the accepted tactics must be employed; that is to say, there must be a persistent lobby—not a lobby in any discreditable sense, but constant solicitation of the delegates by someone whose business it is to present the merits of the proposal it is desired to have accepted. The value of this method of handling its work was fully appreciated by the committee, but the high cost of such services and the danger of unintelligent, but nevertheless weighty, criticism of such use of the funds allotted resulted in a decision not to adopt the plan. Appearances before committees, circularization of the delegates on each of the main proposals and personal letters by such members of the committee as had acquaintance with delegates had, therefore, to form as good a substitute as might be.

The experience, however, is not without decided value to the engineering profession. In the first place there have been formulated some excellent plans, the value of which need not be lost. Presented suitably to the Legislature, much may ultimately be accomplished. The work has resulted in putting engineers before the convention, before the political powers and before the State at large. The newspapers printed considerable material regarding the plans proposed by the profession, and this publicity should insure a still better hearing for proposals made by engineers in future. On the other hand, it has been clearly demonstrated that for results the lobby method is the only one that is effective.

One other lesson it seems possible to draw, and yet its nature is chimerical. If, instead of only one engineer delegate to the convention there had been half a dozen, all strong men, the result might have been quite otherwise. Obviously it is not easy to have them elected to such bodies. While the proportion of men of high caliber was very much larger than one would find in a legislature, the convention was political, and, as experience shows, engineers do not enter much into party caucuses and conflicts. Yet the thought is worth while bearing in mind, and when the first moves are made toward the selection of delegates to such an important body the engineering societies might well take under advisement ways and means of securing satisfactory representation.

The effort demonstrated that representatives of the various engineering societies could work together for a common end. Joint activities are multiplying. Of permanent organizations came first the Fritz Medal Board, then the Engineering Foundation and recently a number of activities of a more or less temporary order. The welding of the bonds between the various National societies more strongly is worth a great deal to the profession at large, and this, certainly, the work of the committee of engineers on the constitutional convention has helped to accomplish.

Forceful Writing and Its Place in Engineering Publicity

IT is said that "any fool can write a book, but it takes a wise man to write a paragraph." Equally true, any engineer can write a report, but few can write a paragraph characterizing the work, or, at least, write it in such a way as to make it attractive and readable to the general public. Most engineers have lost—or perhaps never acquired—the news instinct. They will argue that there is nothing of news in the work which is being carried on about them by their fellow engineers. They insist that there is little of popular interest and that nothing can be said that is worth saying, unless it is embodied in a voluminous report with tables and diagrams.

Yet we have only to glance over the carefully considered and well arranged paragraphs of many of the best-edited newspapers to see again and again references to works which are no more interesting or important than those being carried on in our own immediate vicinity. The news value is brought out by a clever, concise handling of the subject, by bringing into the foreground some one conspicuous item, one which may be well known to technical men, but is practically unknown to the general public.

The Japanese in their houses select out of a store of ornaments a single piece, placing it in what we would consider a bare room. This single piece attracts the eye, stimulates the interest, and is infinitely better appreciated than the fifty or hundred equally valuable works of art which crowd the reception room of the wealthy American. A photograph of the single mountain peak, standing out alone, with its companions in the distant background, rivets the attention, while the view embracing the entire horizon is vague and monotonous. It is this ability to be able to select a single important fact and arrange it with reference to its true value or perspective which constitutes one of the best elements of news.

Novelty is not necessarily news, nor is it the sole requisite for attracting attention. A clearly expressed statement regarding an invention made three thousand years ago, when given briefly and in its relation to modern affairs, may have greater reading value than the description of the latest patent issued.

There is an awakening on the part of engineers to the fact that they have not in the past diffused information regarding the work of their profession. To-day they are suffering to a certain extent because of the ignorance of the public regarding the work which has been done and which can and should now be done in all of the lines of improvement of public health, of better roads and of innumerable conveniences. What is everybody's business is nobody's business. While every engineer is to blame, no one in particular regards himself as culpable for not having done anything in particular to diffuse necessary information. We are awakening to the fact, however, that the responsibility must be located. The nearest and most obvious way is in the local engineering society or the group of engineers which exists in every considerable community. There is a duty first in organizing, and second in taking intelligent action toward diffusing information regarding the engineering achievements, the opportunities, and the needs of the locality.

The first step is to find that rare man who has the sense of news—the man who can write a paragraph which is really readable. While he is rare, he can usually be found in a body of a hundred engineers or men interested in engineering, or at least he can be developed to be a fair substitute for the needed man.

Of course, it means hard work to the young man who is thus designated to be the leader of the local engineering organization in publicity, but the reward to the man who can do it is well commensurate with the effort, not only in the appreciation which properly comes to him, but in the broadening of his education and in his contact with men of affairs.

In considering any work of this kind, there is always one danger which must be clearly kept in mind and on which many a fair publicity scheme has been wrecked. It must be kept free from personal advertisement or even suspicion of it. At all times the action by the local engineering body and by its representative must be kept on a high altruistic plane of benefit to the whole engineering profession and to the community, and not to any one person or clique. If well done, the benefit to the public and to the engineering profession, while not immediate nor showy, will be lasting and substantial.

BUILDING BOMB-PROOFS IS NOT CHILD'S PLAY WHEN THE TEMPERATURE IS AROUND 90 IN THE SHADE

Mobilizing the Engineer Companies of the Militia

National Guard Corps in Encampment at Washington Barracks, Belvoir Tract, Virginia, Build and Demolish Railroads, Bridges, Field Fortifications and Roads

By D. A. TOMLINSON
Assistant Engineer, Chicago & Western Indiana Railroad, Chicago

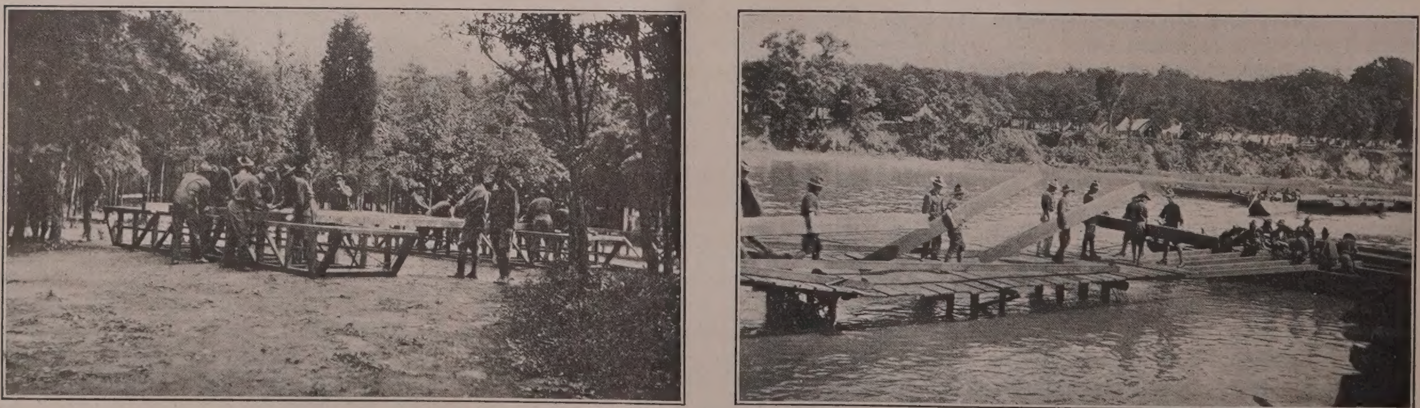
THIS SUMMER the War Department has been mobilizing the engineer companies of the militia from the Eastern and Central States, a battalion at a time, at the summer camp of Washington Barracks, at Belvoir tract, Virginia, about 25 miles below Washington on the Potomac. The companies remain there between ten and twelve days, depending on the distance traveled to reach camp, it being the aim of the War Department that the total time required be limited to two weeks. Early in August companies from Chicago, Calumet, Mich., Philadelphia and Scranton, Pa., were there, together with two companies of army engineers. Practically no infantry drill is required of these companies at camp, the entire time being given to practical instruction in military engineering under the direction of officers of the regular army. The work is very similar to civil-engineering construction and preliminary surveys, the chief difference being that it is conducted under army rules and discipline and that simplicity and speed are more important than precision, permanence or appearance.

The camp consists of several hundred acres of wooded hills and ravines on the Potomac River, far enough from the nearest farm house so that the dynamite used by the "wrecking crew," as the men call the demolition squad, breaks no windows. It affords an opportunity for almost every phase of military engineering; bridge building (both timber and pontoon), field fortifications, road building, camp sanitation, reconnaissance and demolition.

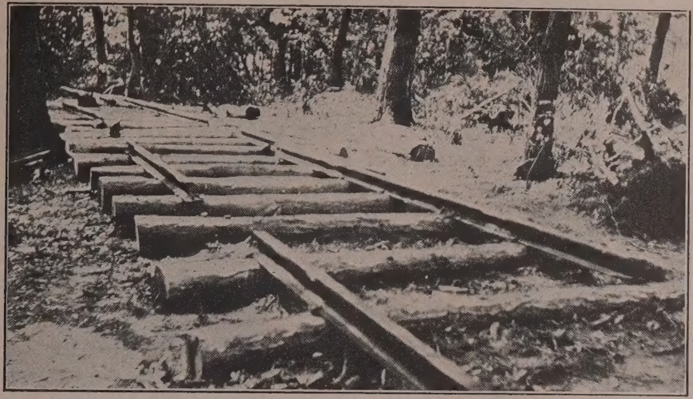
CAMP LIFE STRENUOUS

The regular army routine of camp life is strictly followed. Reveille is at 5.45 a. m., breakfast shortly after 6, and the men are at work before 7. Field instructions and practice in the morning last until noon. After mess the non-commissioned officers "go to school" for two hours, where they are given a series of lectures on army engineering, maneuvers and tactics. In the afternoons the men clean up camp, wash their cloths, clean their guns and equipment and do the other work necessary to maintain themselves and the camp in proper condition. Supper is at 5 p. m. and inspection at 6, when every man must appear in place spick and span. A rusty gun, muddy shoes, tardiness or other offense means duty on the "provost guard" the next day, which requires the cleaning of the officers' tents, digging refuse pits and drainage ditches, disposing of garbage, work in the stables, and other duties which everybody wants to wish upon someone else.

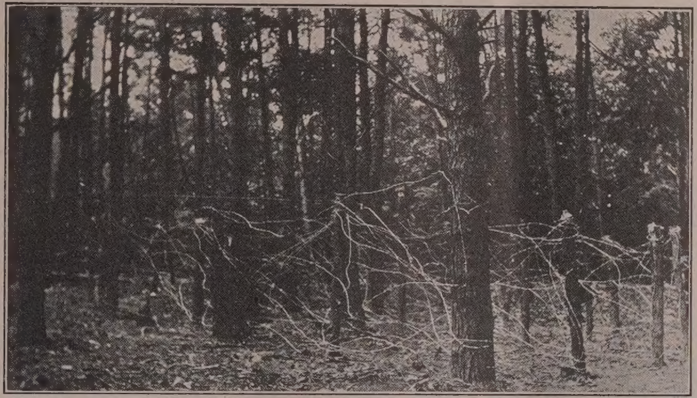
As the camp is 6 miles from the nearest trolley line (the one at Mount Vernon), and 7 miles from a railroad, outside attractions are dimmed by the long hike, and the work receives the men's undivided attention. All the incoming troops are required to march that 7 miles from train to camp, carrying their full equipment—blankets, poncho, extra clothing, tent, haversack, canteen, bayonet and rifle—weighing 60 lb. It is lighter than the marching equipment of most European armies, and the weight is well distributed, but 7 miles, "packing" 60 lb., is a pretty stiff proposition for militiamen only a few hours removed from desks and blueprints, and the memory of that march takes away all desire to see the sights. On leaving camp, after ten days of hard work in the open air, what first seemed like 20



THE BRIDGE SQUAD ASSEMBLES CANVAS PONTOONS, ANCHORS THEM IN POSITION AND BUILDS A BRIDGE ON THEM



DYNAMITING THE RAILS IN A FEW PLACES PUTS THE RAILROAD OUT OF COMMISSION



ONE WORK OF THE FIELD FORTIFICATION SQUAD IS PLACING BARBED-WIRE ENTANGLEMENTS

miles and an unnecessary hardship, assumes proportions nearer the truth, and there is keen competition between the different companies for the distinction of making it in the shortest time.

PRACTICAL INSTRUCTION IN MILITARY ENGINEERING

The men are divided into sections—a bridge section, a field fortification section, a demolition section and a reconnaissance section—the personnel of each remaining intact during camp and each section handling its own work only, it being impossible to give everyone satisfactory training in everything in the time available. As most of the men are engineers and college graduates, a large amount of ground is covered and every hour is made to count.

The bridge sections construct "single-lock" and "double-lock" spar bridges and trestles over ravines, clearing away the underbrush and trees and utilizing them in the bridges. The only material that is not available in the immediate vicinity is rope for lashings, no nails or spikes being used. Canvas pontoons are assembled, launched in the Potomac and anchored in position, and a bridge is laid across them. Similarly, wooden pontoons are launched and anchored, and a pontoon bridge is built. A short piece of railroad roadbed is graded and track is laid. A wagon road is cut through the forest and graded. Each day is given to a different problem and each problem is explained and studied in detail.

The field fortification section digs several different types of trenches, and constructs bomb-proofs, barbed wire entanglements, abbattis and other protective works, both temporary and permanent. This is real work, under a hot August sun, with the thermometer at 90 deg. in the shade and no breeze. Shirts and hats soon come off, and new blisters appear hourly.

THE WRECKING CREW

The demolition section blows up the railroad in several different ways, merely dynamiting the rails in a few places when time is short, or, when possible, blowing up a whole section of track. Similarly the bridges built by the bridge section are destroyed, the pontoons are sunk, and the bomb-proofs are reduced to a mass of wreckage, for the rapid and complete destruction of anything that might be of use to the enemy is as important as its construction for an army's own use.

The reconnaissance sections make a rapid survey, partly on foot and partly on horseback, of the surrounding country, the lithographers taking the sketches as they are brought in each day, combining and copying them, etching the final map upon a zinc plate and taking off as many copies as may be wanted. The first copy is ready within a few hours after the sketchers return with the information. This work is important and hazardous. In actual war the sketchers work ahead of the main army, behind the cavalry screen, and must cover ground rapidly, for information about the country to be covered in the march the following day. Surveys on from 20 to 30 miles must be secured each day, and the maps given to the officers before midnight. The sketchers work in small isolated groups, and are in constant danger of surprise, attack and capture.

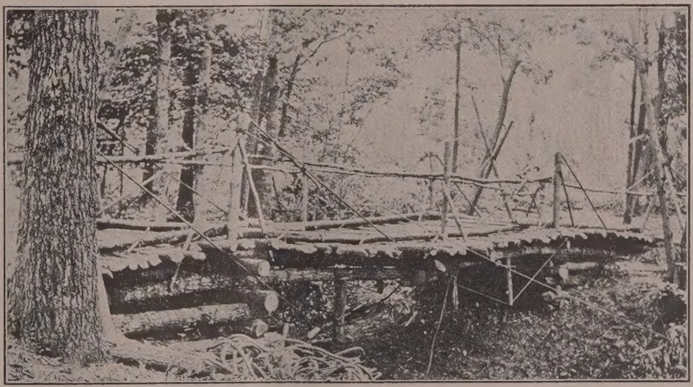
Refuse Dumped from Cart to Scow Without Scattering

New York City's New Dumping Board at Seventy-second Street and East River Eliminates Dust and Other Objectionable Features

SHEET-STEEL CHUTES, into the tops of which ash and refuse carts dump, and the bottoms of which reach nearly to the deck of the scow being loaded, prevent scattering of refuse and reduce the dust to a minimum at New York City's new dumping dock, recently commissioned. This dock, located at Seventy-second Street and the East River, is thought to be an improvement over anything of the kind yet constructed, and is believed by the Department of Docks and Ferries to be the only one ever built on this principle, either here or abroad.

CHUTES RAISED AS ASHES PILE UP

As ashes pile up on the scow being loaded, the chutes are raised by chain blocks. These blocks run on a crane rail consisting of an I-beam carried by the roof trusses, so that each of the three chutes provided may be moved 20 or 25 ft. laterally in loading a scow. The vertical motion provided for is about 8 ft. This range requires two doors, one above the other, which allow opening the full height of the inshore side of



NO NAILS ARE USED IN THE BRIDGES, WHICH ARE BUILT OF NATIVE TIMBER AND ROPE

AFTER THE BRIDGES HAVE BEEN BLOWN UP THE WRECKAGE HAS TO BE CLEARED AWAY the chute, except 2 ft. 4 in. at the bottom.

Each door is made of an upper and a lower leaf. The upper leaf is hinged to the shore face of the chute, and the lower leaf is hinged to the lower edge of the upper leaf, and swings free from it. Two pipe handles, made up of a straight piece of pipe, with a coupling, a nipple and a cap on the lower end, are attached, one on each side, at the hinge between the leaves, and are thrust inward to open the door. The upper leaf swings up into a horizontal position across the chute, and the lower leaf hangs from its edge against the river side of the chute. When in this position each pipe handle is caught by the coupling made up in its lower end, which shoulders against a slotted bracket at the corner of the chute into which the lower end of the handle drops. When the doors are shut the handles hang vertically against the inshore face of the chute.

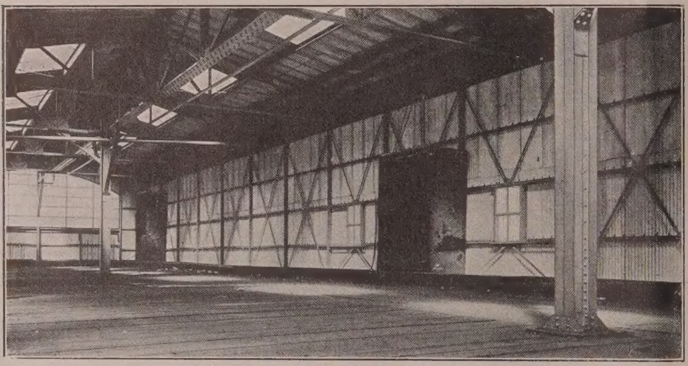
The chutes are made up of light angles and sheet steel of No. 14 gage. They are 3 ft. 6 in. x 7 ft. in plan and 17 ft. 10 in. high, and accommodate a standard two-wheel dump cart.

Construction of Dumping Board

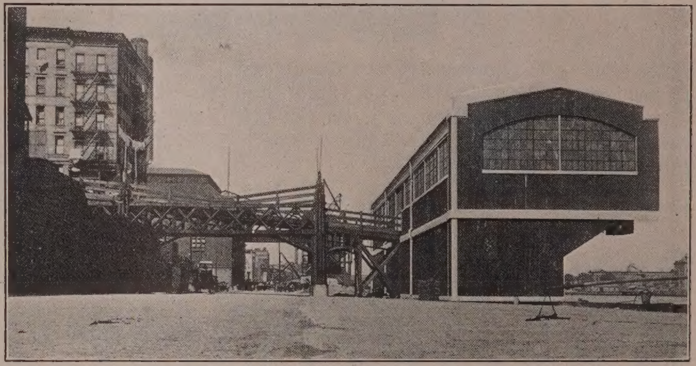
The wood wagon-floor of the dumping board is carried on timber bents, and cantilevers out 15 ft. over the bulkhead line. This floor is a few feet below the level of the end of Seventy-second Street, with which it connects by a bridge. A shutter door is provided at the river end of this bridge, so that the dumping board may be entirely inclosed while carts are discharging, or when not in use.

The deck superstructure, shown in the photographs, consists of a steel-frame roof carried on I-beam columns, which cantilevers out 19 ft. 6 in. over the water. From the roof truss hangs the river wall of the superstructure, and in the slot, 3 ft. 8 in. wide, between this wall and the floor of the dumping board are the steel chutes. The timber underframing is about 21 x 187 ft. in plan, and the steel roof is the same length by about 40 ft. in width. The timber bents, cantilever beams and the under side of the wooden floor are protected against fire with plaster boards.

The dumping board was designed and built under the direction of the Department of Docks and Ferries of New York City, R. A. C. Smith, commissioner, R. C. Harrison, first deputy commissioner, and C. W. Staniford, chief engineer. An earlier installation on the same general plan was designed by Mr. Staniford in 1914 for the dumping board at Seventy-seventh Street and the North River, but has not yet been completed.



DUMPING CHUTES MINIMIZE SCATTERING OF REFUSE



CHUTE VISIBLE UNDER OVERHANGING STRUCTURE

Committee Outlines Best Methods for Sewage Works Operation

American Public Health Association Report Urges Skilled Supervision and Adequate Records of Plant Performance

In its report to the sanitary engineering section of the American Public Health Association, presented at the convention in Rochester, N. Y., this week, the committee on sewage works operation and analytical methods, after outlining the data which should be included in reports of operation, made an urgent plea for competent supervision and laboratory facilities at sewage treatment works, centralization of authority to control stream pollution and approve plans for new sewer systems and treatment works in State boards of health, uniform methods of reporting results of operation, and measurement of the rate of flow of sewage to the plant. If the system for obtaining data, as recommended by the committee, were put in force, State officials, according to the report, would be in possession of a fund of information which could be used to good advantage in advising operators of sewage works as to methods for securing the best results in sewage treatment. The committee is headed by W. L. Stevenson of Philadelphia, chairman, and includes L. I. Birdsall, F. E. Daniels, C. A. Emerson, Jr., C. B. Hoover, H. C. McRae, and Richard Messer. The report, in part, is as follows:

Reiterating the recommendations in its 1914 progress report (see Engineering Record, Dec. 19, 1914, page 674) the committee advocates the tests in Tables 1 and 2 as being most useful for the operating control of sewage treatment plants.

TABLE 1—TESTS RECOMMENDED FOR WORKS DESIGNED PRIMARILY TO PREVENT NUISANCE

A. Works consisting of preliminary processes only, such as fine screens or sedimentation.
  1. Crude sewage:
    a. Nitrogen as organic and as free ammonia.
    b. Suspended matter (called Test Y).
    c. Chlorine.
    d. Avidity for oxygen.
  2. Influent and effluent:
    a. Avidity for oxygen (Test X).
    b. Suspended matter (Test Y).
  3. Sludge drawn from tanks:
    a. Specific gravity.
    b. Percentage moisture in wet sludge.
    c. Percentage of dry residue that is volatile.
    d. Reaction of wet sludge (for two-story tanks only).
  4. Final effluent:
    a. Avidity for oxygen (Test X).
    b. Suspended matter (Test Y).
  5. Sufficiency of treatment as indicated by receiving body of water:
    a. Dissolved oxygen.
    b. Avidity for oxygen (Test X).
B. Works consisting of preliminary and oxidation processes, such as contact beds or percolating filters. (All tests given under heading A, above, and the following additional ones).
  1. Effluent of oxidation process:
    a. Nitrogen as nitrates.
    b. Avidity for oxygen (Test X).
    c. Dissolved oxygen.
    d. Relative stability.
  2. Final effluent:
    a. Nitrogen as nitrates.
    b. Dissolved oxygen.
    c. Relative stability.

Pollution Beyond Safe Limits

The natural growth of cities and towns, and the general demand for complete sewerage facilities add steadily increasing loads upon the water courses while their ability to receive the sewage does not increase and in some cases actually decreases, consequently, the pollution of water courses is becoming more evident and in many instances has gone beyond safe limits.

Incompetent Supervision

It is therefore surprising to learn how few sewage works in America are under competent supervision and provided with laboratory facilities. In fact only a few of the larger plants receive such attention. Municipalities frequently employ expert engineers to study local conditions and to design sewage treatment works, but when such works are put in service their operation is intrusted to an untrained employee, transferred from some other branch of the service, who is totally lacking in knowledge of the complex forces which must be controlled in order to produce the results which the designers intended and for which the funds were invested. This is poor business policy. A municipality or private owner would not attempt to operate a power plant or other installation involving complicated machinery without the services of trained engineers because they know it would not be economical to do so.

Need for Laboratory Control

Where sewage treatment works are of sufficient size to warrant it, laboratory control will allow improvements in methods of operation whereby failures may be averted and the capacity of the plant maintained to an extent which will more than pay for the small expense involved. In the case of a small works the expense of an individual laboratory will usually be prohibitive. However, if there are several such plants in the same neighborhood, it may be possible to obtain the services of an expert operator, provided with a laboratory, to look after all of them, and the expense divided among the

TABLE 2—TESTS RECOMMENDED FOR WORKS DESIGNED PRIMARILY TO PROTECT SOURCES OF WATER SUPPLY

A. Works consisting of preliminary processes and disinfection.
  1. Crude sewage:
     (Same as in Table 1.)
  2. Influent and effluent:
     (Same as in Table 1.)
  3. Sludge drawn from tanks:
     (Same as in Table 1.)
  4. Final disinfected effluent as discharged:
     a. Presumptive test for B. Coli.
     b. Test for avidity for oxygen (Test X).
     c. Test for suspended matter (Test Y).
  5. Sufficiency of treatment as indicated by receiving body of water:
     a. Presumptive test for B. Coli.
     b. Dissolved oxygen.
     c. Avidity for oxygen (Test X).
B. Works consisting of preliminary and oxidation processes and disinfection. (All tests given under heading A, above and the following additional ones.)
  1. Effluent of oxidation process:
     a. Nitrogen as nitrates.
     b. Avidity for oxygen (Test X).
     c. Dissolved oxygen.
     d. Relative stability.
  2. Final disinfected effluent:
     a. Nitrogen as nitrates.
     b. Relative stability.
     c. Dissolved oxygen.

several communities would be very small. It is recommended that designing engineers call the attention of their clients to the necessity and economy of such operating control.

CENTRAL AUTHORITY ADVISABLE

As the great majority of sewage treatment works in America are small and frequently widely separated, it is apparent that the needed expert supervision cannot be obtained locally and that efficiency of operation can only be obtained through some central authority. In several States the legislatures have vested the State boards of health with authority to control the pollution of water courses and their approval is required before sewerage works can be constructed. The State board of health, in its uniform relation to all the municipalities of the State and with similar boards in adjacent States, is in a position to perform such a service to better advantage than any other body now existent in the usual organization of the various State governments of the country.

For the State boards of health to act intelligently they should know the methods of operation and results accomplished in all the sewage treatment works in the State. They would then be able to act as clearing houses, applying to one works the information obtained from several others operating under similar conditions.

The State is interested in seeing that the existing works accomplish the best results possible and the separate communities are naturally ānxious that the works shall meet the requirements at the minimum expense for operation, additions and renewals.

DATA REQUIRED

To obtain these data, information is required on the following:

1. The purpose of the works, i.e., are they primarily intended to protect sources of water supplies or to prevent the creation of nuisance.

2. The construction of the works, i.e., the details of each process which influence operating methods, rather than the stability of the structure.

3. The quantity and character of the sewage to be treated.

4. The methods of operation and results accomplished.

The data concerning the construction of the works should be obtained by the State board of health, either through plans submitted for approval, supplemented by record plans after the works are constructed, or, in cases where the board is not yet clothed with such authority, by means of inspection and measurement. Any changes from the original contract drawings or alterations after the plant is in service should be especially noted, as these may be vital information in connection with operating policies. It presumes that in those States where the law does not require approval of sewerage works before construction, the number of plants is small and hence there should be no difficulty in obtaining the needed data. The records of operation and results accomplished should be furnished the State by the town or owner upon blank forms prepared by the town officials or the owner in conjunction with the State officials.

REPORT FORMS

In preparing such forms it should be borne in mind that the small works are generally operated by employees lacking a technical education, and therefore clearness and simplicity should be obtained by having as much as possible printed, leaving only figures to be filled in. The reports should be printed on sheets either 8½ x 11-in. or of such size as to conveniently be folded to 8½ x 11-in., so as to facilitate filing in standard letter files. It would be desirable to have the sheets made up in the form of pads, so that the operator by placing carbon paper beneath the top sheet could obtain a copy. The record sheets should be signed by the operator and mailed at monthly intervals to the office of the State Board of Health.

FLOW SHOULD BE MEASURED

It is again desired to call attention to the importance of recording essential data. In the majority of sewage treatment works no provision is made to obtain a record of the rate of flow to the plant even though such information is vital to proper operation. The committee strongly recommends that engineers, in designing new works, provide means for easy measurement of the flow, and that measuring devices be installed in existing works not now so equipped.

RESULTS OBTAINABLE

If this system of obtaining data were to be put in force, in a short time the State officials would be in possession of a fund of information which could be used in advising operators of sewage works, and this would not only aid the local communities but also the commonwealth. It would be of further advantage if the State boards of health would use the information so gathered to prepare pamphlets written in clear, popular style, to call to the attention of town officials the need for, and value of, sewage treatment not only as a local matter but in its broader effect upon the commonwealth.

HEALTH EXPENDITURES in 600 Illinois municipalities average 15 cents per capita per year, according to returns to the State Board of Health. The State spends 1½ cents more, but the total is only about 17 per cent of the amount deemed necessary for the purpose by competent authorities. Towns of less than 10,000 people spend 8.1 cents per capita; those from 10,000 to 25,000, 8.6 cents; from 25,000 to 50,000, 15.5 cents (exclusive of garbage disposal), and those from 50,000 to 70,000, 14.9 cents (exclusive of garbage).

W. C. Cushing Discusses Special Steels for Track

Believes Manganese Steel Has Proved Its Worth—Would Continue Trials of Nickel Steel—Urges Other Experimenting

SPECIAL STEELS for track and track appliances are discussed at considerable length by W. C. Cushing, chief engineer maintenance of way, Pennsylvania Lines, Southwest System, in the July *Bulletin* of the American Railway Engineering Association. The paper, which was prepared for the ninth session of the International Railway Congress Association, to have been held in Berlin this year, occupies 193 pages. With its numerous appendices it contains a mass of miscellaneous information on special alloy and special process steel, much of which is uncolored presentation of the experiences and views of others. He also draws certain conclusions of his own, however, which are as follows:

1. Cast manganese steel has been proved by long experience, under exacting conditions, to be a satisfactory and safe metal for the manufacture of frogs and switch points.

2. The trials of rolled manganese steel for rails, and for the manufacture of frogs and switches have not been so extensive as with the cast product, but have been continued to a sufficient degree to enable us to conclude that it will ultimately be entirely suitable for those uses at locations where great strength, toughness and a maximum abrasive resistance are desirable.

3. The experiments with nickel, and nickel and chromium in certain proportions, in rail steel have not, up to the present time, been entirely satisfactory; but the accepted employment of nickel steel in bridge construction, and the trials of nickel and chromium in other proportions in rail steel, especially when incorporated as two of the natural elements of the iron ore, justify continued use.

4. The use of high carbon (over 0.80 per cent) in rails weighing 85 lb. per yard, in combination with 0.92 to 1.00 per cent of nickel, and 0.24 to 0.29 per cent of chromium, has not been satisfactory. The conditions with rail sections of greater weight might be entirely different.

5. Further study of the qualities possessed by high silicon rails, that is, steel with over 0.30 per cent of silicon, is advisable.

6. The value of the use of ferro-titanium in rail steel manufacture as a "physic" for improving the condition of solidity of the metal is conceded, but at the same time steps should be taken to overcome its injurious effect in deepening the "pipe" in the ingot.

7. Heat-treated rails, and those manufactured with the assistance of the electric process, are at present in experimental use only, but the possibility of future value is promising, and the study should be continued.

A COLLAPSIBLE WATER-STERILIZING APPARATUS weighing 12 lb. and capable of sterilizing 5.2 gal. of infected water per minute at a nominal cost, is said to be the recent invention of a doctor in Milan, Italy. It is announced that the apparatus will soon form part of the baggage equipment of Italian troops, thus making immediately available pure drinking water for soldiers in the field.

Decoloration of Stored Water Is Due to Bleaching by Sunlight and Oxidation

Conclusions Reached by Ralph H. Stearns as Result of Study of New England Reservoirs Are Cited at New England Waterworks Convention

BASING his conclusions on studies made on New England reservoirs and particularly those of the Wachusett watershed Ralph H. Stearns of Boston, in a paper read before the New England Waterworks Association at its convention in New York this week, declared that the decolorizing agencies at work are sunlight and oxidation. He cited the records kept at Wachusett and argued from the local conditions that no other agencies could be at work. His studies show that the decoloration at the bottom was about 30 per cent less than at the top in the Wachusett reservoir and that at the Hopkinton and Ashland reservoirs, whose waters are highly colored, the decoloration at the bottom is about one-half that at the surface.

Mr. Stearns' paper, in part, follows:

The results here cited apply to New England river waters, colored with a vegetable stain which originates largely in swamps, from the peat and decaying vegetable matter. There is generally only a very slight turbidity in the water, the sedimentation of which would have but a small effect on the color.

IRON

Iron plays a peculiar part as a coloring agent in reservoir water. A study of the relation of iron to color, made in Boston about 1892, revealed the following facts:

Where there is plenty of dissolved oxygen in the water the iron is kept in its insoluble ferric state and is therefore precipitated and remains on the floor of the reservoir. When the oxygen in the water becomes exhausted this ferric iron may be reduced to its ferrous state by the surrender of its oxygen to the organic matter, and may then be taken up by the water. A lack of oxygen often obtains during the warmer months at the bottom of deep reservoirs, below the plane reached by the circulation of the upper waters, where organic matter is abundantly supplied either by the bottom or the influent water. The colorless ferrous iron upon oxidation imparts a high color to the water, which is gradually reduced to normal again by precipitation of the iron. Iron has appeared on occasions in the Hopkinton and Borden Brook reservoirs, and frequently in Milham Brook, but not in the other reservoirs listed in the table.

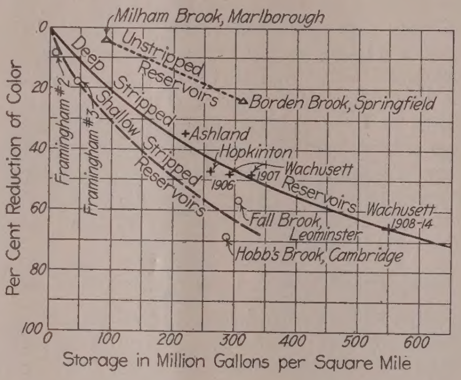
BLEACHING AGENTS

It has frequently been stated that the bleaching of water was due entirely to the agency of sunlight. That sunlight is a bleaching agent was conclusively proved by exposing colored waters in bottles to the sunlight, while similar samples were kept in the dark. The former were in time completely decolorized, while the latter were practically unchanged. Also, by placing bottled water at different depths in a reservoir, the effective bleaching was found to be confined to the upper few feet, while at a depth of 10 ft., in a reservoir water having a color of 40, no appreciable reduction was found after a month's exposure.

The conclusion that bleaching is the result of sunlight alone is, however, not borne out by the actual observations in deep reservoirs. In such reservoirs a complete mixing occurs in the early spring, after which the surface water becomes warmer and of less specific gravity than the lower waters, and vertical circulation between the upper and lower strata ceases entirely until the fall overturn occurs. In this bottom water, thus left stagnant and beyond the reach of sunlight, decolorization goes on, and at a considerable rate.

Taking, for example, the Wachusett records for 1907-1914, the maximum color reached at the dam after the spring overturn averaged 18.6, and this was reduced before the fall overturn to 14.4 at the bottom, as against 12.6 at the surface. In other words, the rate of reduction was about 30 per cent less at the bottom.

At the Hopkinton and Ashland reservoirs, with their highly colored waters, the decolorization at the bottom appears to have been about one-half of that at the surface. It may be urged that the reduction of color at the bottom is due to dilution by ground water, but this is of no such quantity near the dams as to dilute the water of these reservoirs even when drawing them down.



COMPARISON OF DEEP-STRIPPED, SHALLOW-STRIPPED AND UNSTRIPPED RESERVOIRS

OXIDATION

The only other explanation of decolorization at the bottom is slow oxidation without sunlight. As the dissolved oxygen in the water at the bottom of a stripped reservoir supplied with good water does not become exhausted, this seems the rational explanation. The failure of bottled water to bleach was probably due to lack of oxygen and insufficient time.

The decolorization of water by storage, then, is apparently pure bleaching, brought about by sunlight and by oxidation, and taking place at the bottom of deep reservoirs in cases where there is plenty of dissolved oxygen in the water as well as at the surface. The bleaching action, while always going on, is greatly accelerated during the summer months, and becomes a minimum when the reservoir is covered with ice.

It appears that the reduction in color is proportional to the initial color—that is, the percentage reduction is independent of the initial color. Also, it has been shown that decolorization will continue to completion, both in bottles and in large natural lakes.

RESULTS AT WACHUSETT

The reservoirs which were studied, as seen in the table below, were mainly those of the Metropolitan Water supply, but a few others were added where reliable records of influent and reservoir colors were available. The results are based on averages of from five to fifteen years, which tend to neutralize any anomaly of a single month or year.

Reduction of color is not only a function of the storage per square mile, which is the base used in the accompanying diagram, but also of the run-off per square mile. The number of days that the average yield is held in storage would be the more logical base, but the one used shows the results closely enough and is definite.

The results appear in the accompanying table and diagram. The diagram shows as abscissæ the storage capacity of the reservoir per square mile of watershed, and as ordinates the percentage reduction in color of the inflowing river water resulting from its passage through the reservoir.

It will be seen that the curves determined by the points plotted show a progressive reduction in color as the storage per square mile increases. This reduction in the case of the Wachusett amounts to 66 per cent. The line for unstripped reservoirs is added only to indicate the general position on the diagram, as the data are too limited and too variable in this case to justify any analysis.

The maximum color of the influent of the Wachusett for any month was 70, while the maximum of the reservoir near the dam for any month was 29. This color resulted

DECOLORIZATION OF WATER BY STORAGE

Name of Reservoir and Supply	Years Used in Average	No. of Years Used	Area of Water-shed, Sq. Mile	Storage Capacity Total	Storage Capacity Sq. Mile	*Yield Per Sq. Mile Mil. Gal.	Length of Storage Days	Average Depth of Res'r, Ft.	Color of Influent Water	Color of Water at Dam	Per Cent Color Reduction
Stripped Reservoirs											
Wachusett	1908–1914	7¼	118	65,000	550	0.894	615	48	43.5	14.7	66
Wachusett	1907	¾	118	38,600	327	0.920	355	39	45	23	49
Wachusett	1906	1	118	34,500	292	1.043	280	38	46	24	48
Hopkinton, Sudbury	1895–1897 1899–1903	8	5.86	1,520	260	1.111	234	25	113	60	47
Ashland, Sudbury	1891–1897 1899–1903	12	6.43	1,416	220	1.066	206	26	100	65	35
Reservoir No. 3, Sudbury	1891–1896	6	27	1,180	45	1.012	45	15	84	69	18
Reservoir No. 2, Sudbury	1900–1903 1905–1914	14	47	530	11.3	0.863	13	12	76	69	9
Fall Brook, Leominster	1898–1903 1905–1913	15	1.26	386	306	1.075	285	14	36	15.5	57
Hobbs' Brook, Cambridge	1900–1913 1905–1914	14	7.25	2,097	289	0.863	335	14	59	18	69.5
Unstripped Reservoirs											
Borden Brook, Springfield	1910–1914	5	8	2,500	312	0.925	338	36	75	57	24
†Milham Brook, Marlborough	1901–1903 1905–1913	12	3.56	315	88	0.853	103	15	47	45	4

*Based on Machusett or Sudbury records for the years given. †Stripped to 10 ft. below flow line, but oxygen becomes exhausted in deep portion.

from the 1907 floods, before the reservoir had filled for the first time. In 1911, as a result of very small inflow, the bleaching action went on until the color was reduced to 7, which color obtained from the surface to the bottom of the reservoir. This color was maintained for a period of three months, while the color of the influent for these same months, which was of considerable quantity, averaged 45.

RESULTS IN OTHER RESERVOIRS

The color of the influents of the Ashland and Hopkinton reservoirs on a few occasions exceeded 200 during the months of small run-off of the years above noted, while the maximum recorded color of the reservoir water near the dam was 107 for the Ashland and 96 for the Hopkinton reservoir.

The colors for the month of each year in which the color was a maximum were averaged in the case of the Wachusett, Ashland and Hopkinton reservoirs, and the reduction in color was found to be about five-sixths of the average reduction for the year shown in the diagram, when compared with the same influent colors. This indicates the insurance against the highly colored water reaching the distribution system.

Evidence, other than the bottle experiments, which points to the effect of sunlight in accelerating the bleaching, is found in the shallow Fall Brook and Hobbs' Brook reservoirs. These have an average depth of 14 ft., and show a much greater percentage reduction in color than the Ashland and Hopkinton reservoirs of about the same storage per square mile but of higher color and almost twice the depth. The bleaching which takes place in the upper few feet of the reservoir is apparently many times as rapid as that which occurs beyond the range of the sunlight, but, due to intermixing with the waters just below, complete decolorization at the surface of reservoirs is never accomplished. These considerations would indicate the advantage of shallow reservoirs in this respect.

The results at Borden Brook and Milham Brook reservoirs show the effect of leaving the soil, etc., on all or a large part of the reservoir bed. For a period of years color is absorbed from the reservoir bed, and this in a measure offsets the normal decolorization due to storage. There are instances where for this reason the reservoir color exceeds that of the influent streams.

POINT OF WITHDRAWAL

In order that advantage can be taken of the bleaching effect, it is, of course, necessary that the supply be taken from the lower end of the reservoir and that the greater part of the inflow shall be at the more distant points. In such a case, a somewhat imperfect piston action takes place, and the raw river water travels but slowly toward the outlet. To obtain the best results the reservoir capacity should exceed the maximum run-off of the winter and spring months, in which case most of the influent would be subjected to a summer's bleaching before using.

Where a large portion of the inflow comes in near the lower end of the reservoir, a more general mixture of the water occurs. Even if it all comes in at the upper end, it is conceivable that an abnormally cold or warm inflow, having a greater or less specific gravity than the reservoir water, might run along the surface of, or beneath, the reservoir water and later become generally mixed with it. In the last two cases the reduction would be the result of dilution and would yield a less desirable effluent. There is evidence of a slow circulation in all reservoirs, due to winds and temperature changes, together with the piston action.

It should be noted that the great capacity of the reservoir otherwise improves the quality of the water, but the reduction of the color to an inappreciable amount is one of the requisites of a satisfactory supply. The Wachusett reservoir seems to have performed this function acceptably.

Longleaf Pine Distinguished Visually from Loblolly or Shortleaf

Size of Pith in Conjunction with Diameter of Second Annual Ring Found to Give Reliable Test Without Aid of Microscope

By ARTHUR KOEHLER

Expert in Wood Identification, U. S. Forest Products Laboratory, Madison, Wisconsin

A DETAILED study of the wood of longleaf, loblolly, and shortleaf pines has recently been made at the U. S. Forest Products Laboratory, Madison, Wis., for the purpose of determining whether differences could be found by which the botanical species can always be distinguished. Previously no absolutely reliable means of identification had been known. A number of characteristic features were discovered in each species and, as far as observations have been made, they bid fair to distinguish positively between the species. Although the grading of structural timbers has lately been placed on a basis of density (shown by rate of growth and percentage of summerwood), irrespective of species, yet it is often desirable to know the botanical name of a specimen.

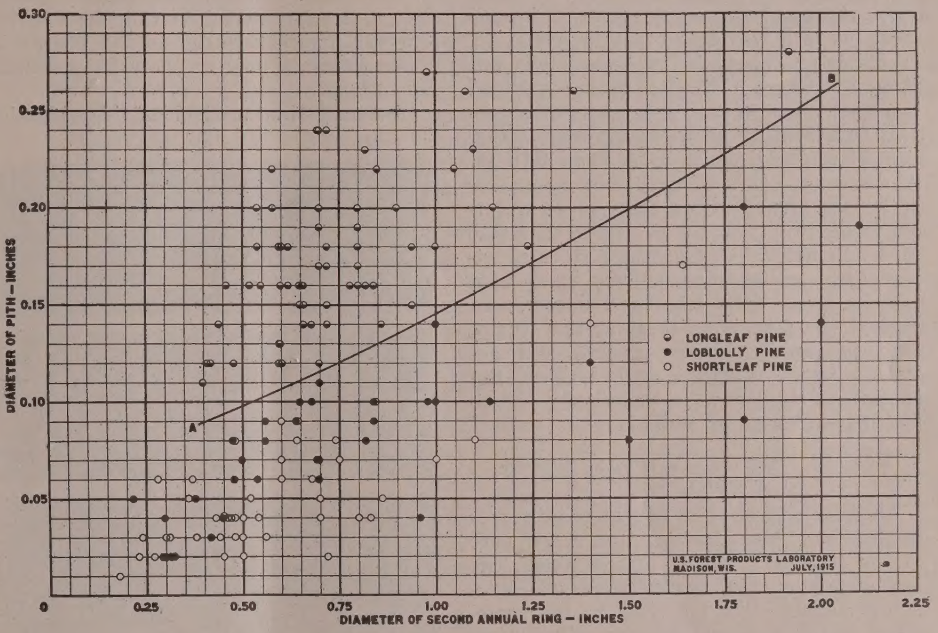


FIG. 1—RELATION OF PITH DIAMETER TO DIAMETER OF SECOND ANNUAL RING

SIZE OF PITH AND OF SECOND ANNUAL RING

The pith of longleaf has been found to be more than 0.10 in. in diameter in all normal specimens examined, while in loblolly and shortleaf it was found to be less, except in specimens of vigorous growth. The vigor of the tree at the time the pith was formed in any part of the stem is indicated by the diameter of the first few annual rings surrounding the pith at that point. Therefore, it was found that by taking the diameter of the second annual ring into consideration, together with the diameter of the pith, longleaf can also be separated from shortleaf and loblolly even when the latter have a pith more than 0.10 in. in diameter. So far no exceptions have been found to the rule.

Fig. 1 shows the diameter of the pith of each species plotted against the diameter of the second annual ring. Each circle represents a separate tree. From the diagram it will be seen that whenever the pith in loblolly or shortleaf was found to be more than 0.10 in. in diameter the diameter of the second annual ring was considerably larger than that found in longleaf having the same sized pith. The line *AB* was drawn so that these points which fall above the line represent longleaf and those which fall below it represent loblolly or shortleaf.

The diameter of the second annual ring was chosen for these measurements because it gave more satisfactory results in separating the species than the first annual ring alone. In longleaf, even in slow-growing specimens, the first annual ring is comparatively large (see Fig. 3). This is evident from the fact that the yearly shoots are nearly always coarser in this species than in loblolly and shortleaf. Therefore, in specimens having a pith of 0.11 in. or a little more in diameter the first annual ring of shortleaf or loblolly (fairly rapid growth) is only slightly larger than the first annual ring of longleaf (slow growth). The second annual ring in such specimens, however, is quite narrow in longleaf and fairly wide in the other two species, thus

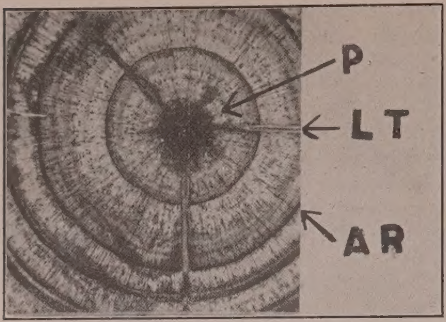


FIG. 2—SECTION OF LONGLEAF PINE
P, pith; A.R., limit of second annual ring; L.T., leaf trace

adding to the degree of separation. (It will be noticed that the diameter of the second annual ring includes the first also and is not the difference between the two.) Rings farther out were not considered, because they do not indicate as well the vigor of the tree at the time the pith was formed.

A careful analysis of the data obtained shows that out of 127 specimens of longleaf, representing eighty-three different trees, no pith was found less than 0.11 in. in diameter except in two specimens cut at a point where a whorl of branches joined the stem. Out of 110 specimens of shortleaf, representing sixty-six different trees, only fifteen had a pith more than 0.10 in. in diameter. Out of sixty-four specimens of loblolly, representing forty-seven different trees, twenty had a pith more than 0.10 in. in diameter. Usually the pith in shortleaf and slow-growing loblolly was about 0.08 in. or a little less in diameter. In general the pith is smallest at the stump, becomes rapidly larger upward and decreases again in the crown. All of the specimens studied were botanically identified by the leaves or cones.

How to Measure Pith and Second Annual Ring

The pith of the pines can be readily recognized as a small, darker and softer core in the structural center of the stem. The second annual ring is clearly defined by a distinct darker line (see Fig. 2) but sometimes the first annual ring is rather faint and care must be taken not to mistake the third annual ring for the second. Occasionally dark bands, or false rings, are found in the wood (see first and second rings of Fig. 4), but these can be distinguished from true annual rings by the fact that their outer limit is not defined by a sharp line, as is always the case with true annual rings. Measurements made on a section where knots join the center of the stem are not reliable for identification. At such points the pith may be unusually small or the rings irregular, and the other end of the specimen should be examined.

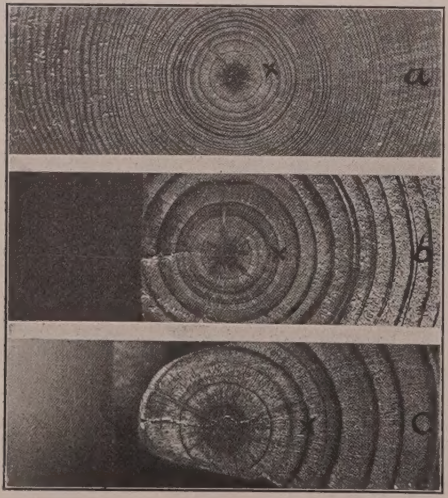


FIG. 3—LONGLEAF PINE
a, slow; b, medium; c, rapid growth near center; x, second annual ring

To measure the pith and second annual ring properly it is first necessary to cut with a sharp knife a smooth surface showing these structures. Moistening the wood often brings out the structural features more clearly. With a rule graduated in twenty-fifths or fiftieths of an inch, the average diameter of the pith not including small projections can be measured. A reading glass or low-power hand lens is helpful but not essential in making this measurement.

If the intersection of the lines on the diagram representing the diameter of the pith and of the second annual ring of a specimen falls below the line *AB* it indicates that the specimen is not longleaf and may be either loblolly or shortleaf. Should the point of intersection fall close to the line *AB* a measurement on the other end of the specimen may result in more definite indications.

Obviously this method of identification can be used only on timbers, ties or other pieces containing the pith, but it is, as a rule, only regarding large pieces that the lumberman or contractor is anxious to know the exact species. Furthermore, this method does not exclude the minor Southern pines, which, however, are comparatively rare in the lumber markets. Occasional pieces of Cuban pine might be classed as longleaf by this method.

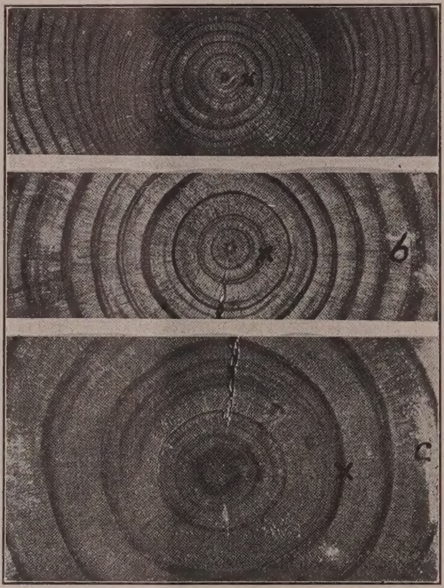


FIG. 4—LOBLOLLY PINE

Microscopical Differences

The more minute microscopical distinctions found for these three species can not be given in detail here. Briefly it may, however, be said, that the leaf traces, vertical resin ducts, medullary rays, especially those containing resin ducts, and the ray tracheids afford helpful and dependable criteria for identification of the species.

The leaf traces can be seen but not measured with the naked eye in the first and second annual rings, where they appear as numerous miniature "knots" (Fig. 2). They are a continuation of the woody part of the leaf clusters that clothe each year's new growth and persist for several years. The leaf traces, like the leaf clusters, are largest in longleaf and smallest in shortleaf. In loblolly they are intermediate and overlap the other two species in size.

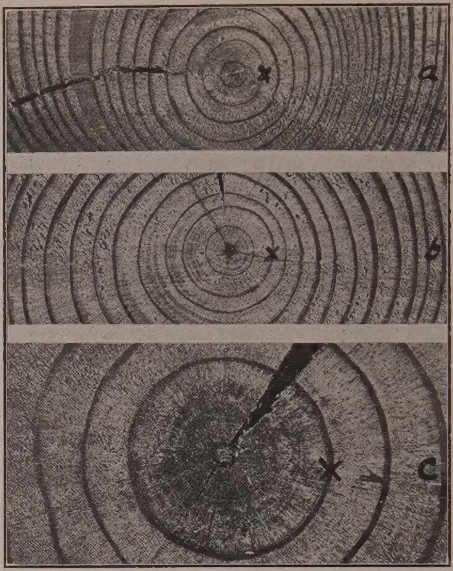


FIG. 5—SHORTLEAF PINE

The vertical resin ducts and the medullary rays containing the horizontal resin ducts also were found to average considerably larger in longleaf than in the other two species. The projections on the walls of the ray tracheids were found to be less reticulate in loblolly, as pointed out by Penhallow in *North American Gymnosperms*, but this feature was found to be influenced to some extent by the rate of growth.

Summary for Visual Method

1. See if pith is present at the ends of the stick. (If not present the specimen can not be identified without a microscope.)
2. With a sharp knife smooth the pith and surrounding wood. If knots are present at that point try the other end.
3. If the pith is not clear try moistening the smoothed surface.
4. With a finely graduated rule carefully measure the average diameter of the pith. Use a reading glass or low-power hand lens if available.
5. If the pith is 0.10 in. or less in diameter the specimen is not longleaf.
6. If the pith is more than 0.10 in. in diameter also measure the diameter of the second annual ring. Be careful not to mistake the first or third annual ring for the second.
7. On the chart find the point of intersection of the line representing the diameter of the pith with the line representing the diameter of the second annual ring.
8. If this point is below the line *AB* the specimen is not longleaf.
9. If this point is above the line *AB* the specimen is longleaf, or, in rare instances, it may be Cuban pine.
10. If the point of intersection is close to the line *AB* make measurements on the other end of the specimen.

The Production of Pig Iron for the first half of 1915 is reported in bulletin 6 of the Bureau of Statistics of the American Iron & Steel Institute as 12,233,791 gross tons.

Proposed Government Testing Flume for Hydraulic Turbines Not Needed

Holyoke Flume Is Ample for Purposes of Research, and Acceptance Tests for Purchasers Should Be Made Only on Actual Installations

By H. BIRCHARD TAYLOR
Hydraulic Engineer, I. P. Morris Company, Philadelphia

THERE appeared in the Engineering Record of March 20, page 379, a canvass of opinions on the desirability of a new testing flume for hydraulic turbines. This canvass was prompted by the report of a committee of the Boston Society of Civil Engineers recommending that the Government undertake the construction of such a flume. An abstract of the report appeared in the Engineering Record of March 7, 1914, page 273. The American Society of Mechanical Engineers has recently appointed a committee to investigate the same subject. In view, therefore, of the renewal of the effort to promote this project, the writer is prompted to record a few comments regarding some aspects of the question, and to explain the answers which he submitted to the canvass mentioned above.

Some of the reasons stated for urging the project are, in the words of the Boston committee, as follows—quoting from the abstract mentioned:

"Waterwheels have increased so much in size in recent years and are operated under so much higher heads, that there is no place in the United States where they can be adequately tested before their final installation.

"The Holyoke testing flume . . . is no longer large enough, nor does it have sufficient head to meet all of the present-day needs. . . .

"The art of waterwheel design is still in rather a crude state and needs such authentic and reliable information as the proposed flume will furnish. . . ."

TWO PURPOSES OF FLUME

In considering the questions involved, there are certain facts, some of which are not as generally recognized as they should be by engineers or by the non-technical public, which bear upon the question and should be kept clearly in mind. There are two purposes for which such a testing flume may be used. These two uses are entirely distinct from each other and should not be confused. The first and more important is the use of such a flume for experimental research of the turbine designer; the second, the testing of waterwheels for acceptance by the purchaser.

In considering the first use of the flume, it should be understood that it is not in general necessary to carry out experimental research on full-sized turbine units of the dimensions used in actual installations, but, on the contrary, for much of this work, turbines of moderate size, but constructed so as to be geometrically similar to installed units, may be used much more conveniently. A testing flume need not be large enough to admit full-sized turbines under the full operating head expected in a plant, and there are many advantages in keeping the experimental head low. Since the power increases rapidly with the head, the difficulty of absorbing large amounts of power would add enormously to the expense of testing. The testing in a flume of full-sized turbines, such as are installed in large modern plants, would of course be impossible, even if it were necessary or desirable on account of the enormous dimensions of many of these turbines.

RESEARCH ON SMALL MODELS AT HOLYOKE SATISFACTORY

In spite of the imperfect knowledge of many of the laws of hydraulics, there are a few relations which are not open to question and which do not need experimental verification. One of these is that variation of size alone of a turbine has slight effect on its efficiency or characteristics, and the comparative tests can be made just as well on small sizes of units as on large. A change of head has a similar slight effect on the efficiency and performance, so that within reasonable limits tests can be made as well under low heads as under higher heads. The power and speed of turbines are changed according to known laws when either size or head is altered. Therefore, for the purpose of research, while a greater range of head and the opportunity to install larger apparatus might be a benefit in some cases, in the majority of investigations these advantages would not be important, and much of the experimental work required in the present and future development of turbines can be done about as well at the existing flume at Holyoke as in such a new testing flume as is proposed. The Holyoke flume is open for general use, and has been engaged in testing turbines for the past thirty years. Although the flume is subject to a few limitations when used for present requirements, it nevertheless has been in the past, and is at the present time, an exceedingly useful resource for American turbine builders.

There are certain modifications which could be made in the flume at moderate cost, and it is undoubtedly desirable that some of the apparatus installed should be replaced by more modern equipment. But in spite of these limitations, the flume is eminently satisfactory for the majority of tests which are required in experimental research by the builders. There are, of course, a few questions, such as the effect of a great increase of head on turbine operation, the gain in efficiency due to a very great increase in size of unit, and the probable life of high specific speed turbines under moderate or high heads, which are waiting for experimental solution. Some of these problems, however, could scarcely be solved in any testing flume, and all of them can be best worked out in actual installations.

NEW FLUME WOULD NOT PAY

Considering the limited field of work available and the restrictions of the expense which engineers are usually able to incur in connection with tests, there is small likelihood that any new testing flume would be even approximately self-supporting, so that no privately owned or Government owned competitor of the Holyoke flume would be in any position even to pay expenses. There are, however, reasons for many manufacturers preferring a private flume to a publicly owned one for such tests, in order that tests be not given publicity during the development period of new apparatus.

It may be urged that the conservation of our National resources is of such vital importance to the economical welfare of the country that it would justify the Government incurring a considerable amount of expense in measures to increase the efficiency with which our water powers are developed. In this connection, however, it should be recognized that the weak and inefficient features of the great majority of existing plants are not the turbines proper, but the general arrangements of the plants and the design of the water passages outside of the turbine runner and guides. The only portion of this system of water passages capable of being tested in a flume is the turbine itself. When the wonderful improvement which has been made in the last few years in the performance of turbines tested at the Holyoke flume is taken into consideration, it must be granted that American engineers have carried the development of the turbine itself to such a point that only slight further gains in efficiency are possible. On the other hand, the designs of turbine settings and other parts of the power plant exterior to the turbines are grossly defective in a great number of installations in this country. But this part of the installation cannot be adequately investigated in a testing flume.

SHOULD NOT BE USED AS TEST FOR ACCEPTANCE OR REJECTION

In regard to the second use of the flume, it will be recalled that a number of years ago it was common practice for American engineers to have turbines tested out at Holyoke before installation in a plant, acceptance or rejection being made on the basis of the Holyoke test. Many of the older installations in New England were contracted for in this way. This practice was found to lead to such great discrepancies between the actual results in place and the Holyoke tests that it has become generally discredited. If it is intended that the new Government flume shall be again used for such a purpose, then the writer is most strongly opposed to the entire project. Such a return to a discredited system of testing would be a decided retrogression in engineering practice. The spectacle of engineers of power companies accepting turbine equipment on the sole basis of tests made at Holyoke is a sorry one indeed, and this practice has had much to do with the delay in adopting scientific methods in waterwheel construction. It is safe to state that neither the Holyoke testing flume nor any other testing flume could be made adequate for acceptance tests of turbines.

The greatest handicap which American turbine development has had to contend with has been the dearth of tests on completed plants. It is a fair statement that the great majority of American waterpower installations have been accepted without any attempt to measure the water consumption or to compute the operating efficiency. This ill-advised policy is in line with a popular notion that water available for power purposes is free to anyone and is of no value. If we had to include in our accounts an actual charge for every cubic foot of water used, in the same way that coal or other fuel is charged, all would appreciate the importance of efficient apparatus. The charge for water actually exists, whether it is specifically entered on the accounts or not. The policy of omitting tests entirely or limiting them to Holyoke tests has not been due only to the engineers in charge of plants, but has been encouraged by the builders of stock turbines, to their own ultimate injury.

EFFICIENT WHEELS IN DEFECTIVE SETTING

An efficient runner may be installed in a casing of such design, or may discharge into such a form of draft tube, or may be located at such a distance above tailwater, that the experimental results obtained at Holyoke will have no relation to the performance after installation. A recent case, for instance, has come to light where one of the American stock builders obtained an efficiency of 90 per cent on a runner tested at Holyoke, while the same design of runner installed in a defective setting in the case of a large unit developed in place under operating conditions a maximum efficiency of 76 per cent. The present agitation for a new testing flume is, perhaps, the result of experiences of this kind, of which there have been many, in connection with the output of the builders of the cheaper sort of machinery. Such occurrences will, however, not be made less frequent by the construction of any sort of testing flume, since the errors result, not from incorrect tests but from improper designs of the turbine setting in the final installation.

A new testing flume could do little to bridge the gap between experimental results and actual performances. As the modern form of the American turbine unit, especially in low-head installations, is almost invariably of the vertical shaft, single-runner type, with volute casing usually molded in concrete, and a long, curved draft tube, the high results obtained in a number of recent plants are due, not to the runner alone but to the design of the entire system of water passages. These could not be duplicated, except at prohibitive cost, in an experimental flume. There is, besides, no reason for attempting to duplicate them. Is not the rational solution of this whole matter a general adoption of a practice which is now confined to a few of the larger plants; namely, the testing of the actual full-sized plant after its completion and before the machinery is accepted by the owners of the plant? Whether tests made at an experimental flume are made on models or full-sized wheels, and regardless of the head used in the experiments, results of such tests should never be accepted by the purchaser as equivalent to the efficiencies which will be secured in the final installation, although it is of course possible to predict the final result when sufficient data are available from tests on existing plants.

MORE NEED FOR OTHER RESEARCH

In almost every line of engineering there are certain unexplorable fields calling for experimental investigation, some of great importance, justifying a large expenditure of money in an effort to obtain reliable data on which new construction can be based, and others involving points which are already covered by satisfactory data. In selecting lines of experimental investigation and research, those problems should be attacked in which the need of information is the greatest. The question is not simply whether it would be desirable, in the interests of enlarging our scientific knowledge, to have available such a flume as suggested, but whether the need of this installation is a sufficiently vital one to justify the very heavy expense which would be involved, and whether the same expenditure would bring more valuable returns in this application than if applied to other lines of experimental work. If the statement of the committee, that the art of waterwheel design is still in rather a crude state is true, will the proposed flume necessarily remedy this condition?

It may be further pointed out that it is necessary, in the case of the builders of the better class of machinery, to use the Holyoke flume only when experimental data are required on new departures in design, for conditions which extend beyond the range of theoretical data of known reliability, or in cases where it is desirable to insure the success of an important installation by checking the design experimentally. In view of the remarkable success secured in a number of very notable developments carried out by American engineers in the last few years, it is surprising to meet the statements quoted above, that the art of waterwheel design is still in "rather a crude state." This is certainly not a fair statement of conditions, and is a reflection on American turbine construction which is no longer deserved in the case of the work done by the best turbine builders, although, as mentioned, there has been a certain class of machinery to which it applies.

CONCLUSION

Summing up the above, it is believed that the practice of the past in accepting turbines on the sole basis of results secured in an experimental flume has no proper place in modern engineering; a large part of the work available for a testing flume is, therefore, eliminated. For purposes of research of turbine builders, the testing of small models under low heads is eminently satisfactory when supplemented by comparative data obtained from tests in place of full-sized plants, and the existing Holyoke flume can still be satisfactorily used.

Two other points may be appended; first, the fact that the Holyoke flume has value on account of the excellent basis of comparison between different experiments derived from the use of unchanged methods of testing through a long term of years; and, second, the inadvisability of giving undue weight to experimental results secured at Holyoke, or any other testing flume, since the experimental wheels of various builders may vary considerably in workmanship and finish, and may bear no close relation to the type of construction furnished in actual turbine installations.

In conclusion, the writer believes that, while a new flume would be desirable for experimental research, there is not sufficient demand to justify the expense of its construction for that purpose alone; and he warns against the other possible use, or rather misuse, of a flume—that is, for the purpose of replacing the testing of the actual performance of completed plants. The latter practice has taken years to overcome, and its re-adoption would be a misfortune.

New California Road Overcomes Mountain Barrier

Ridge Route to Connect Bakersfield and Los Angeles, a State Trunk Line of Great Economic Importance

By N. D. DARLINGTON
California State Highway Commissioner

A MOST interesting section of the California State highway system now under construction is the Ridge Route road, 115 miles in length, connecting Los Angeles with Bakersfield. The latter city is located in the upper end of the San Joaquin valley and is separated from Los Angeles by the Tehachapi Mountains, along whose ridges the new road winds for many miles at an average elevation of approximately 3000 ft. The new route between the two cities will be 60 miles shorter than that via Tehachapi Pass and 35 miles shorter than the Tejon Pass road.

ECONOMIC ADVANTAGES

Tremendous economical importance attaches to the new road because the San Joaquin valley, lying immediately north of the Tehachapi Mountains, is the largest and most productive valley in the State and will undoubtedly sustain at some future time a population of four or five million people. On the other hand, the district lying south of the Tehachapi Mountains, of which Los Angeles is the center, is a thickly populated and rapidly growing community, important as the terminus of such a road because, as a distributing center, it is vitally interested in having close connections with large agricultural areas. These two sections of the State with widely different interests, which make them all the more important to each other, have

DRY RUBBLE WALL CARRIES THE ROAD AROUND A SHARP NOSE been heretofore separated by a mountain barrier through which no direct route has been provided, and now that a thoroughfare representing the best engineering practice of the day is being constructed it is well worth while to observe what interest on the investment in this road will accrue to the State, especially as that investment is rather heavy compared with average highway costs. Much of the territory does not and cannot contribute much toward the cost of the traffic of the road.

It is difficult to compute the economical value of saving in distance which it has been possible to effect, and the value of this highway will become more and more apparent as the years go by. Los Angeles is to-day the headquarters for most of the oil companies operating in the San Joaquin valley fields, and it is natural to suppose that she will always maintain her position as the oil center of California. A tremendous traffic has been built up in recent years in the use of motor trucks and trailers in serving this interior district, and with the new highway completed it will be possible to deliver truck loads of oil supplies from Los Angeles to the oil fields in one day.

This new route obviates the necessity for passing through Antelope valley or the Mojave desert, with their intense heat and high winds. Going from Los Angeles to Bakersfield via either of these routes means a long, hard day's journey, but over the new road it will be one of the most pleasant and beautiful trips on the State highway system. At almost every turn panoramas of mountain scenery are presented. Over the Ridge Road it will be possible to leave Los Angeles in the morning, lunch at Bakersfield and return to Los Angeles in the evening without breaking the speed laws.

HEAVY CONSTRUCTION

Recognizing the importance of this road the State Highway Commission has prescribed a type of construction which makes it in every respect representative of the best California highway practice. In most cases throughout the State where highways are constructed in mountainous districts, the widths of the roads have been reduced, but in this particular instance the full width of from 21 to 24 ft. has been maintained. The maximum grade is 6 per cent and no reasonable expense was spared in eliminating sharp curves.

The total cost of the highway now under construction by the State between the two cities will probably approximate $1,500,000, or about $17,000 per mile. Some parts of the road involve very heavy construction. On one contract about 14½ miles in length the estimated excavation necessary amounted to 635,000 cu. yd. and in order that the road might be opened in time to serve the public during the Exposition the contractor was obliged to move this yardage within a period of six months. To accomplish this two steam shovels were kept in operation on this section for twenty-four hours a day, making shifts of eight hours each or the equivalent of six shovels on ordinary eight-hour-per-day runs. This section is now being rushed to completion by a force of between 300 and 400 men and 250 teams. The road was to have been completed and thrown open to through traffic on Aug. 20, 1915.

RIDGE ROUTE WINDS OVER MOUNTAINS AT AN AVERAGE ELEVATION OF 3000 FEET

Course Which Gives Broad Training in Business and Economics

Massachusetts Institute of Technology's Experience Shows It to Meet a Great Demand

REFERENCE has been made several times in this journal to the course in engineering administration started last year at the Massachusetts Institute of Technology, and recently (see Engineering Record, July 17, 1915, page 64) there was editorial comment on the first year's work. Because of the interest displayed in the subject a fuller explanation of the course than heretofore made in this journal is given below.

PURPOSE OF COURSE

The course in engineering administration provides a training for men who expect to enter positions concerned with the management or administration of manufacturing, construction and transportation enterprises which demand a knowledge of scientific and engineering principles. It combines with instruction in general engineering, studies in the methods, economics, and law of business.

The course includes (1) the instruction common to all courses in the institute in literature, language and history, and in chemistry, physics and mathematics; (2) a choice of engineering studies classified under three options: civil engineering, mechanical and electrical engineering, chemical engineering, and (3) a selected group of subjects in business and economics. While the amount of time assigned to engineering subjects is less than that prescribed in the other courses of the institute, the fundamental subjects have been retained which will enable graduates to fill many of the positions open to engineers.

TABLE 1—STUDIES FOR SECOND YEAR

First Term	Hours Ex.	Hours Prep.
Mathematics	45	90
Physics	75	60
Physical Laboratory	15	15
Political Economy	45	45
German	30	45
English Literature	30	30
History II	30	30
Options		
1. Mechanism	30	60
Descriptive Geometry	45	0
2. Mechanism	30	60
Descriptive Geometry	45	0
3. Quantitative Analysis	120	15
Second Term	**Hours Ex.**	**Hours Prep.**
Accounting	45	45
Banking	45	60
Physics	75	60
English Literature	30	30
Options		
1. Applied Mechanics	45	90
Surveying	30	0
Mathematics	45	90
Physical Laboratory	5	5
Precision of Measurements	10	10
2. Applied Mechanics	45	90
Mathematics	45	90
Physical Laboratory	20	20
Precision of Measurements	10	10
3. Quantitative Analysis	120	15
Mechanism	30	60
Foundry Work	45	0
Physical Laboratory	20	20
Precision of Measurements	10	10

TIME GIVEN TO BUSINESS SUBJECTS

Approximately one-fourth of the total time of the curriculum is given to business subjects which are primarily chosen so as to train students to analyze commercial and industrial problems. In this group special emphasis is placed upon accounting, business law, the industrial organization of society, and business management.

The course in accounting is designed to be of service to administrative officers in the analysis of accounts and financial reports, rather than to make bookkeepers, auditors or accountants in a technical sense. Cost accounting includes methods of determining costs of material, processes, labor, and machines; distribution of indirect costs and overhead expenses; cost data to secure economy, and inventories. Business law treats of contracts, agency, negotiable instruments, sales and patents. The two extended subjects of industrial organization and business management deal with the

TABLE 2—STUDIES FOR THIRD YEAR

First Term	Hours Ex.	Hours Prep.
Industrial Organization	30	60
Statistics	60	0
Report Writing	30	30
Heat Engineering	45	90
Physics: Heat	15	20
Physical Laboratory	15	10
Options		
1. Applied Mechanics	60	90
Railroad Engineering	20	40
Elements of Electrical Engineering	30	30
Electrical Engineering Laboratory	15	30
2. Applied Mechanics	45	90
Elements of Electrical Engineering	45	75
Machine Drawing	60	0
3. Theoretical Chemistry I	45	75
Theoretical Chemistry Laboratory	27	18
Organic Chemistry	30	30
Mechanical Engineering Drawing	45	0
Metal Turning	45	0
Second Term	**Hours Ex.**	**Hours Prep.**
Industrial Organization	45	45
Transportation	30	45
Securities and Investments	45	45
Heat Engineering	45	60
English Composition and Literature	45	75
Options		
1. Structures	45	90
Railroad Engineering	20	20
Materials	30	35
2. Applied Mechanics	45	90
Mechanical Engineering Drawing	105	0
3. Theoretical Chemistry I	45	75
Theoretical Chemistry Laboratory	27	18
Organic Chemistry Laboratory	75	0

TABLE 3—STUDIES FOR FOURTH YEAR

Option 1—Civil Engineering

First Term	Hours Ex. Prep.	Second Term	Hours Ex. Prep.
Cost Accounting	45– 45	Business Management	60–110
Business Management	45– 75	Business Law	30– 60
Business Law	30– 60	Structures	45– 90
Taxation	15– 15	Structural Design	75– 0
Structures	45– 90	Hydraulic Engineering	30– 60
Railroad Engineering	30– 60	Hydraulic Laboratory	15– 5
Theoretical Hydraulics	30– 60	Sanitary Science	15– 0
Testing Materials Laboratory	30– 0	Thesis	125
Foundations	15– 30		

Option 2—Mechanical and Electrical Engineering

First Term	Hours Ex. Prep.	Second Term	Hours Ex. Prep.
Cost Accounting	45– 45	Business Management	60–110
Business Management	45– 75	Business Law	30– 60
Business Law	30– 60	Machine Design	60– 0
Taxation	15– 15	Hydraulic Engineering	30– 60
Machine Design	90– 0	Engineering Laboratory	90– 0
Theoretical Hydraulics	30– 60	Central Stations	30– 60
Testing Materials Laboratory	30– 0	Thesis	130
Electric Light and Transmission of Power	30– 60		
Electrical Engineering Laboratory	45– 45		

Option 3—Chemical Engineering

First Term	Hours Ex. Prep.	Second Term	Hours Ex. Prep.
Cost Accounting	45– 45	Business Management	60–110
Business Management	45– 75	Business Law	30– 60
Business Law	30– 60	Industrial Chemistry II	105– 15
Taxation	15– 15	Elements of Electrical Engineering	30– 30
Industrial Chemistry	45– 90	Electrical Engineering Laboratory	45– 45
Applied Mechanics	60–105	Thesis	190
Engineering Laboratory	60– 30		

financial operations of corporations and the conduct of business from the standpoint of the individual employer. They include a treatment of the organization of the executive force, departmental functions, factory efficiency, standardization of goods, stock keeping, routing of orders, management of labor, efficiency methods, marketing of goods, publicity and advertising, credit department, insurance and business ethics. Among other subjects included in the group of business studies are banking, statistics, report writing, transportation and securities and investments.

The studies for the first year of the course are the same as those in the regular engineering courses. Differentiation starts in the second year. The studies after the first year are shown in Tables 1, 2 and 3. The hours indicated show the amount of time assigned to exercises and that estimated as necessary for outside preparation. In addition to the studies shown there is certain prescribed reading during the summer vacations.

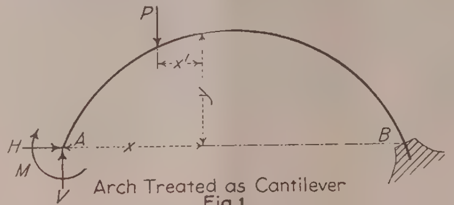
ELECTROLYTIC TESTS, made by the engineers of the New York Board of Water Supply to determine the danger of corrosion to the Bryn Mawr siphon of the Catskill Aqueduct, indicated that the steel pipe carried several volts from trolley tracks at Tuckahoe Road to the Bryn Mawr connection chamber. Here the current left the steel pipe through a 2-in. line supplying the hydraulic cylinders of the valves, returning through the Yonkers water mains to the railway company's sub-stations. As electrolytic action always takes place where the current leaves the conductor, and as the current passes directly from the siphon to the 2-in. pipe without passing through any earth, it was decided that the steel siphon was safe from electrolytic corrosion.

Graphical Analysis of Arches with Fixed Ends Greatly Simplified

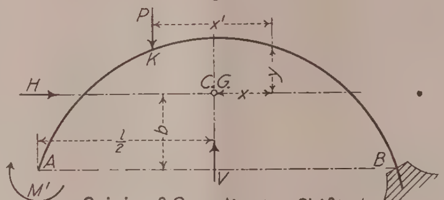
Influence Lines for Reactions and End Moment Easily Constructed —Simple Method for Obtaining Deflections Under Loading

By C. S. WHITNEY
Steel Inspector for Gustav Lindenthal, Consulting Engineer, New York City

THE GRAPHICAL method to be explained in this article is probably the simplest and most direct method possible for determining the reactions of an arch rib with fixed ends under moving loads, and the effect of displacements of the abutments. Graphical methods are sufficiently accurate for practical design, because no great refinement in the solution of such problems is warranted; the solutions all depend upon the fundamental assumption of rigid supports, which is well known to be inexact. Although this method is in wide use in Germany it is comparatively unknown in this country. All the advantages of graphical methods in simplicity and ease of checking are inherent in the solution given.



Arch Treated as Cantilever
Fig.1



Origin of Coordinates Shifted
Fig.2

FIGS. 1 AND 2—FUNDAMENTAL RELATIONS

FUNDAMENTAL THEORETICAL ANALYSIS

Applying the theory of virtual displacements, the rib may be treated as a simple cantilever fixed at the right end as shown in Fig. 1. The external forces acting on this cantilever are the horizontal reaction H, the vertical reaction V, the moment M at the left end and the superimposed vertical concentrated load P. If there is no displacement of the abutments, the x, y and angular displacements of the left end of the cantilever produced by these external forces must be equal to zero. If $\Delta_R x$ is the horizontal displacement of the left end produced by the reactions, $\Delta_P x$ that produced by the load P, and $\Delta' x$ the horizontal displacement of the abutment which it is desired to consider, and analogous symbols to represent vertical displacements, settlement and angular changes, the following expressions may be written:

$$\left.\begin{aligned} \Delta_R x + \Delta_P x + \Delta' x &= 0 \\ \Delta_R y + \Delta_P y + \Delta' y &= 0 \\ \Delta_R \varphi + \Delta_P \varphi + \Delta' \varphi &= 0 \end{aligned}\right\} \quad (1)$$

Taking the left-hand end as the origin of co-ordinates, the moment M_R produced at any point by the reactions is $M + Vx - Hy$. Using the three fundamental equations for displacement as derived in textbooks on mechanics, there can be written

$$\Delta_R x = \int_A^B \frac{M_R y ds}{EI} = \int_A^B (My + Vxy - Hy^2)\frac{ds}{EI}$$

$$\Delta_R y = \int_A^B \frac{M_R x ds}{EI} = \int_A^B (Mx + Vx^2 - Hxy)\frac{ds}{EI}$$

$$\Delta_R \varphi = \int_A^B \frac{M_R ds}{EI} = \int_A^B (M + Vx - Hy)\frac{ds}{EI}$$

It will be seen that if the origin of co-ordinates be moved to the "center of gravity" of the arch rib the values of the three terms

$$\int_A^B y ds,\ \int_A^B x ds \text{ and } \int_A^B xy ds$$

will be zero, and if the rib is divided up into small lengths so that $\Delta s/EI$ is constant (C) the above equations become, since M, V and H are constants,

$$\left.\begin{aligned} \Delta_R \dot{x} &= -HC\sum_A^B y^2 \\ \Delta_R y &= VC\sum_A^B x^2 \\ \Delta_R \varphi &= nM'C \end{aligned}\right\} \quad (2)$$

In the last equation the term n is the number of divisions of the arch ring and M' is no longer the true moment M at the left end; the true moment is

$$M = M' + Hb - Vl/2$$

in which b is the vertical distance from the ends to the "center of gravity" of the arch ring and l is the span of the neutral axis. The moment M_P of the superimposed load is equal to Px'. Hence

$$\left.\begin{aligned} \Delta_P x &= \int_A^B M_P y ds = -PC\sum_K^B yx' \\ \Delta_P y &= \int_A^B M_P x ds = -PC\sum_K^B xx' \\ \Delta_P \varphi &= \int_A^B M_P ds = -PC\sum_K^B x' \end{aligned}\right\} \quad (3)$$

Then substituting formulas 2 and 3 in 1, dividing by the constant C and solving, there is found

$$\left.\begin{aligned} H &= -P\frac{\sum_K^B yx'}{\sum_A^B y^2} + \frac{\Delta' x}{C\sum_A^B y^2} \\ V &= P\frac{\sum_K^B xx'}{\sum_A^B x^2} - \frac{\Delta' y}{C\sum_A^B x^2} \\ M' &= P\frac{\sum_K^B x'}{n} - \frac{\Delta' \varphi}{Cn} \end{aligned}\right\} \quad (4)$$

From these equations the reactions produced by superimposed load, temperature change, rib shortening or displacement of the abutments can be determined. For instance, the shortening of the arch rib chord due to temperature change or rib shortening may be substituted for $\Delta' x$ and then

$$H_t = \Delta_t / C\sum_A^B y^2 \quad (5)$$

In this case V and M' are zero. The moment in the arch rib at any point due to

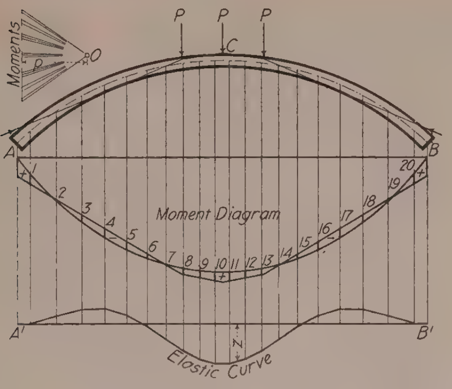


FIG. 4—ELASTIC CURVE FOR DEFLECTIONS

temperature change or rib shortening is therefore equal to $H_t y$.

GRAPHICAL CONSTRUCTION FOR SINGLE LOAD

The reactions produced by any load P acting at any point are given by equations 4, with the omission of the last terms. The graphical solution of these three equations is extremely simple. As an example, the arch treated in Turneaure and Maurer's "Principles of Reinforced Concrete Construction," page 354, will be analyzed and the results compared with the analytical values there obtained. The arch has a span of 100 ft., rise of 20 ft., crown depth of 30 in., and depth at haunch of 42 in. The arch ring is divided into twenty parts of such length that $\Delta s/EI$ is constant. The complete graphical analysis is given in Fig. 3.

It will not be possible in this brief treatment to explain the construction and properties of funicular polygons, but that may be found in any book on graphics. In this case the funicular polygons are all drawn just as though the values laid off on the load lines were forces acting at the centers of the divisions of the arch ring.

APPLICATION TO EXAMPLE

Since the value of y in equation 4 is measured from the gravity axis of the arch ring, the center of gravity must first be located. This is done by considering the values of $\Delta s/EI$ (which were made equal) to be forces acting horizontally, and finding their center of gravity by the ordinary graphical method as shown by the force diagram and funicular polygon 1.

The division of the arch rib to make $\Delta s/EI$ constant is usually accomplished graphically by the well-known method of similar triangles plotted on a diagram for moments of inertia.

DETERMINATION OF H

After the gravity axis has been located the values of y are measured and laid off algebraically on the load line of the force diagram (pole at $O_{2\,\&\,3}$). The pole distance p' is arbitrary. The value of $\sum_A^B y^2$ is obtained from the funicular polygon 2 which is drawn with its sides normal to the rays of the force polygon 2, and

$$\sum_A^B y^2 = z_1 p'$$

Funicular polygon 3 is drawn with its sides parallel to the rays of the force diagram and

$$\sum_K^B yx' = -z_K' p'$$

The horizontal thrust at the left end, by equation 4, is therefore

$$H = Pz'_K/z_1$$

The value of H for a concentrated load at any point is thus equal to a constant P/z_1 multiplied by the ordinate of the funicular polygon 3, and hence the smooth curve tangent to this funicular polygon is itself the influence line for H.

DETERMINATION OF V

The reaction V is the vertical reaction at the left end and is obtained by the construction of the funicular polygon 4. The values of x are laid off in order algebraically on the load line of force diagram 4 and the pole O_4 is located at an arbitrary distance p''. Funicular polygon 4 is drawn with sides parallel to the rays of the force diagram. Then

$$\sum_A^B x^2 = z_A''p''$$

and

$$\sum_K^B xx' = z_K''p''$$

or, by equation 4,

$$V = Pz_K''/z_A''$$

The smooth curve tangent to the polygon A″B″ is the influence line for V.

DETERMINATION OF M

The summation $\sum_K^B x'$ is given by the ordinate of the funicular polygon $A'''B'''$, which has its sides parallel to the rays of the force diagram 5. The load line is composed of n equal division and the pole distance may very conveniently be made equal to $2n$. Then

$$\sum_K^B x' = z_K'''p''' = 2nz_K'''$$

or by equation 4

$$M' = Pz_K'''p'''/n = 2Pz_K'''$$

The moment M at the left end is equal to $2Pz_K''' + Hb - Vl/2$ when $p''' = 2n$, and the moment M_c at the crown is $2Pz_K''' - H(h-b) - Px$, in which h is the rise of the neutral axis. Px is the moment of the load P about the crown, and is zero when the load is on the right of the crown.

Turneaure and Maurer give the final and preliminary divisions of the arch ring, the former considering the effect of the steel reinforcement and the latter neglecting it. The writer analyzed both cases graphically and it is interesting to note that the maximum error due to neglecting the steel was about 2½ per cent, although the divisions themselves were quite different. There is, however, only about 1.1 per cent of steel. In spite of the small scale of the drawings, the greatest difference between the graphical and the analytical results was 2.3 per cent, all the values for V being within 0.15 per cent. The V line, which checked the closest, was drawn to the largest scale. All of the polygons should be drawn to about the same scale, so that the accuracy will be uniform, and their construction should always be checked.

DEFLECTION OF ARCH RIB

The elastic curve of a fixed arch under any load can be drawn by the simple construction shown in Fig. 4, and the deflections computed from it. The vertical deflection at any point K, relative to the tangent at A, due to any loading is given by the fundamental equation

$$\Delta y = \int_A^K Mx \frac{ds}{EI} = C \sum_A^K Mx$$

The summation is obtained by the usual graphical construction of a funicular polygon, using a "force" diagram in terms of moments M.

The three central panel points have been loaded in this example, and the reaction lines first determined from the influence lines for H, V and M. The bending moment diagram is then drawn as shown. The arch rib is divided so that $\Delta s/EI$ is constant and the center points of these divisions are projected downward in parallel lines. The intercepts on the moment diagram are approximately the average moments for the different divisions of the ring, and these intercepts are laid off to scale vertically on the load line of the "force" diagram, positive moments downward and negative moments upward. The pole length (p) is arbitrary. The funicular polygon $A'B'$ drawn with sides parallel to

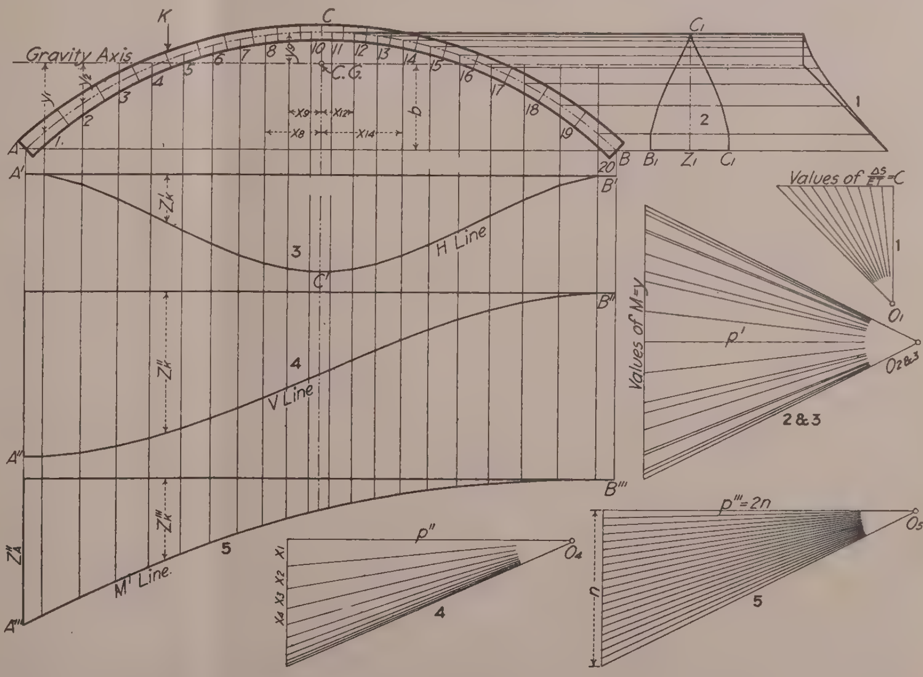


FIG. 3—GRAPHICAL DETERMINATION OF RELATIONS H, V AND M BY INFLUENCE LINES

the rays of the "force" diagram is the elastic curve of the rib for the assumed condition of loading. From the elastic curve the vertical ordinate z of any point may be sealed, and the displacement is equal to zpC.

Influence lines may be drawn for moments and stresses at any section of the arch ring by analytical methods, using the influence lines for H, V and M' and noting that with the origin at the center of gravity, calling y minus below and x minus to the right, the bending moment at any point due to the left reactions is

$$M_R = M' - (Hy + Vx)$$

Only the case of the symmetrical arch under vertical loads has been considered here, because that case is the simplest and the one which most commonly occurs in practice. In its general form the method is a little more elaborate, but it may be applied to unsymmetrical arches and to horizontal or oblique loading. When an arch rib bears a permanent static load, a direct graphical analysis may be made for the one condition of loading and the true pressure line located without the use of trial equilibrium polygons. The method of making such an analysis will be explained in a second article, which will discuss the conduit given by W. M. Smith in the Engineering Record of May 22, page 648.

Experiences in Calking Joints of Water Mains

Leadite After Ten Years of Use Declared by Speaker at Waterworks Convention to Be Far Superior to Lead

After using leadite for calking water-main joints for ten years, W. C. Hawley, chief engineer and general superintendent of the Pennsylvania Water Company, Wilkinsburg, Pa., has concluded that it is far superior to lead, and can be used in place of the latter in every instance except occasionally in a street when a joint immediately under some pipe or other obstruction is inaccessible, and would thus be troublesome to reach in case it leaked and could be repaired by a little calking. His reasons for favoring leadite were given in detail in a paper read before the convention of the New England Waterworks Association in New York this week. Mr. Hawley finds also that for ease in application, for resistance to shock and to the passage of electric current, and cost, leadite has decided advantages over lead.

The following paragraphs give the chief points made by Mr. Hawley:

Watertightness

When leadite joints have been properly made, a large percentage of them when tested should be found to be practically tight. There may be a small amount of seepage, and in a very few cases even an appreciable leakage indicated by water dropping from the joint or small spray. Practically all of these will take up tight within twenty-four hours, and such as do not become tight are readily made so by cutting out the portion which is leaking and rerunning with leadite, or in case there is too much water the portion of the joint which has been cut out can be filled with lead wool. If more than 1 or 2 per cent of the joints made show leakage after twenty-four hours, it is an indication that the joints were not properly made. In a line of 12, 10 and 8-in. pipe, 5 miles long, laid several years ago and tested in the open trench, there was but one leaking joint. This was repaired by cutting out part of the joint and rerunning.

Lead has but one advantage over leadite, namely, that after having been run the joint can be calked. The calking adds materially to the expense of the joint, but there will be occasionally in a city street a joint immediately under some pipe or otherwise inaccessible, where it may be advisable to use lead so that in case of the joint being disturbed and leaking in the future it can be readily repaired by calking, whereas if it was leadite it might be necessary to run a new joint or to cut out part of it and replace with lead wool.

Advantages

In practically all other respects leadite has the advantage over lead. Leadite costs about 10 cents per pound, lead about 5 cents; but leadite weighs about one-fifth as much as lead, and hence its cost per unit of volume is about two-fifths that of lead. Leadite requires no calking, and this, as will be shown later, is a material saving, not only in the cost of the labor of calking but in the digging of large bell holes. In addition there is the saving in cost of inspection in order to insure well-calked joints. There is the further saving in the maintenance of the ditch and bell hole during the time that the joint is being calked and inspected. This is an important item in bad ground or in wet trenches.

In a case where there is limited room for calking, leadite has marked advantage over lead. Some years ago I had a 30-in. pipe burst, the bell of which was very close to a concrete wall. It was barely possible to yarn and run the joint with leadite. Had we been compelled to use lead it would have required hours of time to have cut out sufficient concrete to have permitted the calking of the joint. It was imperative that the pipe be repaired quickly, as a large community depended upon the line for its supply.

Leadite has another advantage over lead in the fact that it is so much lighter and hence more easily carried to the joint. When lead is at a temperature suitable for pouring it oxidizes rapidly, and in spite of the utmost care the oxide and dross which gathers on the surface will sometimes be poured into the joint. There is no trouble of this kind with leadite.

Elasticity

Since lead has practically no elasticity, any movement of pipe laid with lead, or any continued shock or vibration to the pipe tends to loosen the lead in the joints, or in many cases to squeeze it out altogether. Leadite being elastic, is not so affected. In one case a 20-in. cast-iron pipe laid with lead passed under a main line of a railroad on which the traffic was very heavy. For years it had been necessary to periodically uncover that pipe and recalk the joints. About ten years ago the lead in these joints was replaced with leadite, and I am advised that there has not been a leak in these joints since.

Considering the brittle nature of leadite, it is surprising what a leadite joint will stand in the way of movement without serious damage. This has been illustrated in my own experience several times by side hill slips, and in one case where it was necessary to lower a line of 8-in. pipe for a distance of nearly 300 ft. and to a maximum depth of about 2 ft. The pipe had been laid with leadite and it was not supposed that it could be lowered without damage to most of the joints, which would probably require them to be remade. It was decided, however, to try the experiment, and the pipe was lowered and to our surprise the joints remained tight.

Since leadite melts at such a low temperature (240 deg. Fahr.), there is no danger of an explosion, should it be necessary to run a wet joint. Among leadite's good qualities is the fact that it offers a high resistance to the flow of electricity, thereby reducing materially the danger of damage by electrolysis.

Saving

Last but not least of leadite's good qualities is the saving by its use compared with lead. Roughly speaking, on the ordinary sizes of pipe and under average conditions, this amounts to at least one-half of the cost of lead joints. In my own experience, since leadite was a new material and our pressures unusually high, I have made leadite joints with a depth of from 2⅛ to 2½ in., whereas with lead the joints would be made from 1¾ to 2 in. in depth. Used in this way we find on the average that the amount of leadite and lead required for joints of different sizes is as shown in the accompanying table.

Average Quantities of Leadite and Lead Required for Joints of Various Sizes of Cast-Iron Pipe

Diameter, in.	Leadite, lb.	Lead, lb.
4	2 = (Diam./2)	7 = 2 Diam. — 1
6	3 "	10 = 2 Diam. — 2
8	4 "	13 = 2 Diam. — 3
10	5 "	17 "
12	6 "	21 "
14	7 "	25 "
16	8 "	29 "
20	10 "	37 "
24	12 "	45 "
30	15 "	57 "
36	18 "	69 "

On this basis, assuming the cost of leadite at 10 cents per pound and lead at 5 cents, lead costs from one and three-quarters to nearly twice as much as leadite.

Labor costs vary according to the length of pipe laid and the difficulties encountered, but we have found on the average the labor in making leadite joints, including the melting of the material, the preparation and placing of the roll, yarning and pouring the joint, is one-half of the corresponding cost of making lead joints, including the calking, this without making any allowance for the extra cost of inspecting lead joints or for digging bell holes large enough for calking. As an example of what can be done under good conditions, we have had three men yarn, melt and pour ninety-five joints of 8-in. pipe in one day, at a total cost for labor of $6.60, or a cost of 7 cents per joint. The total cost including leadite was $49, or an average cost per foot of pipe of 4.3 cents. In this case the saving is well over 50 per cent of the cost of making the same joints with lead.

A Campaign Against Typhoid Fever will be conducted by the new California State sanitary engineering department, recently established for the purpose by the State Board of Health at Sacramento. Prof. Charles Gilman Hyde, of the University of California, has been named consulting engineer and Chester G. Gillespie will be chief engineer of the new department.

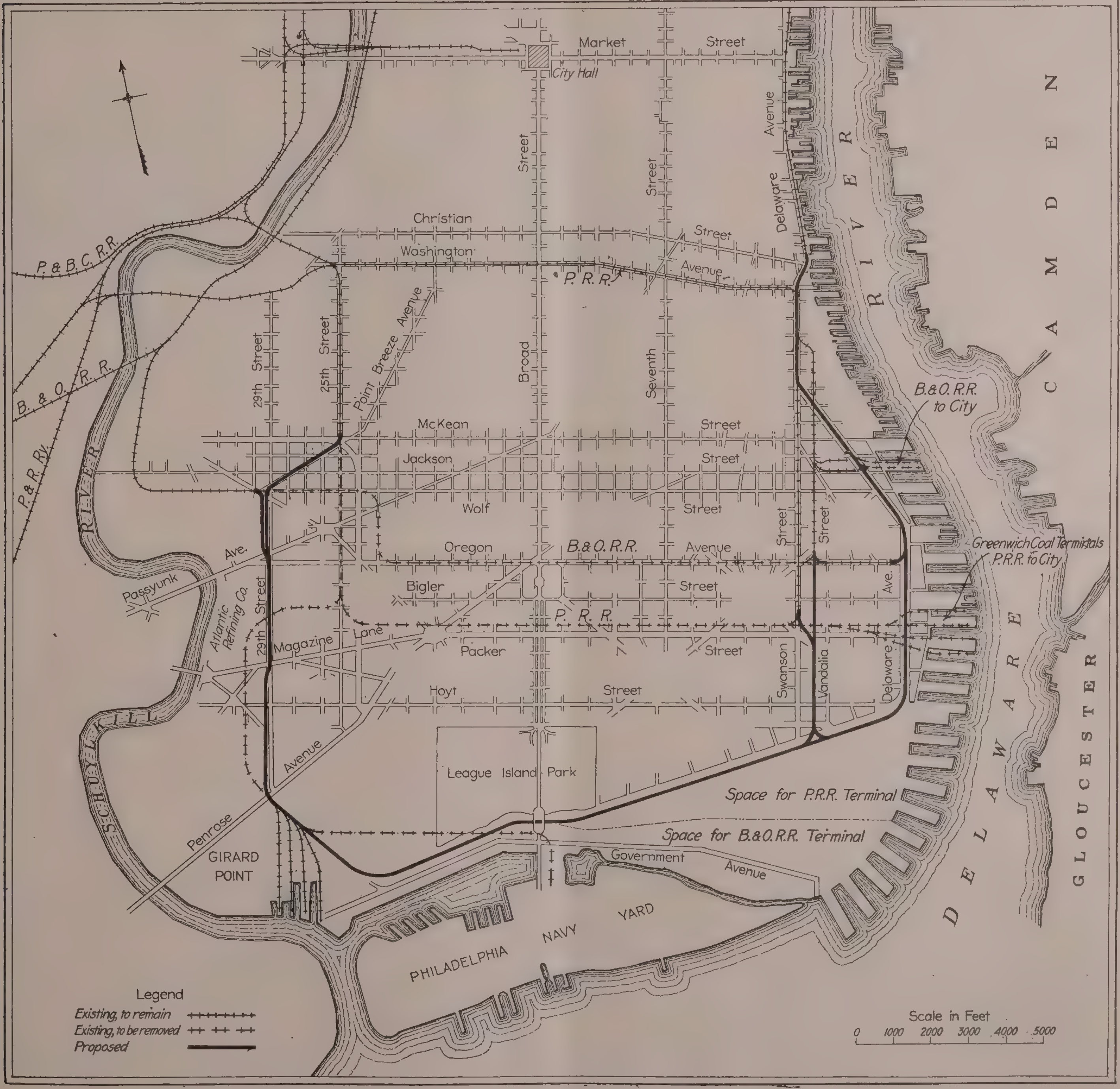
$24,000,000 South Philadelphia Railroad Improvement Now Well Under Way

Elimination of Grade Crossings, Consolidation of City-Owned Waterfront and Opening of Large Undeveloped Tract Are Main Objectives

ACTUAL construction of the $24,000,000 South Philadelphia railroad improvement was started last April, and while comparatively few of the details have as yet been worked out, surveys and plans are being made, and at several points the changes are well under way. The improvement affects an area of nearly 4 miles square, bounded by Christian Street on the north, the Delaware River on the east, the Philadelphia Navy Yard on the south and the Schuylkill River on the west. When the work is completed all grade crossings within the area, except in the waterfront district adjoining Delaware Avenue, will have been eliminated; the railroad tracks in Oregon Avenue, which form a natural barrier to development south of that avenue, will have been removed, together with the other potential barrier of tracks north of Packer Street; and, perhaps most important of all, the Pennsylvania and Baltimore & Ohio Railroads, in exchange for extensive tracts for water-terminal and yard development just north of the navy yard, will have turned over to the city waterfront property farther up the Delaware River, giving the city its first ownership of enough continuous waterfront to permit a definite and adequate plan of development. In addition, the two railroads will have equal rights to a belt line skirting the entire tract, and at the same time any other railroad at any future time may connect to and use the belt line on fair terms.

WHAT THE PROJECT INVOLVES

Referring to the general map, the essentials of the project are as follows: The line of the Pennsylvania (Philadelphia, Baltimore & Washington) across the city in Washington Avenue is to be elevated as a two-track structure; the other two lines across the city, that of the Baltimore & Ohio (Schuylkill River East Side Railroad) in Oregon Avenue and that of the Pennsylvania (Delaware Extension) north of Packer Street, together with the Girard Point and navy yard branches, are to be abandoned and removed; to replace them a single belt line will be built inclosing a much larger area and reaching the entire Delaware River waterfront from Christian Street south, as well as the Philadelphia Navy Yard, the Girard Point grain elevator and the large industries along the Schuyl-



GENERAL MAP OF THE TERRITORY AFFECTED, AND ITS LOCATION WITH REFERENCE TO THE CITY HALL kill River; all grade crossings in the district will be eliminated, except in the waterfront section adjacent to Delaware Avenue; the Baltimore & Ohio Railroad will release to the city its waterfront property between McKean and Jackson Streets, a frontage of 900 ft., and the Pennsylvania Railroad will likewise surrender its Greenwich coal terminals on the waterfront at Packer Street, a frontage of 2500 ft., with which combined frontage of 3400 ft. as a nucleus the city hopes to acquire the intervening 3500 ft. of mostly undeveloped waterfront and thus secure a continuous frontage of 1 1/3 miles, and the city will begin at once construction on the site of the Greenwich terminals of the first of a series of 300 x 1200-ft. piers, to be known as the Moyamensing development; in substituton for the frontage given up by the railroads, provision is made for acquiring land for more adequate developments, side by side, between Hoyt Street and the navy yard; both railroads will have the unrestricted right to use the belt line at all times, without in any way surrendering the exclusive use of their yards, piers or other terminal facilities, and will be further protected by individual vested ownership in two tracks each, and the right-of-way therefor; and finally, the "belt line" principle is made of general public application by provision that the Philadelphia Belt Line Railroad, a railroad controlled by Philadelphia trade organizations, or any other railroad, may at any time become users of the main tracks of the system by paying a suitable rental as provided in the agreement, with authority to lay two additional tracks, under the Philadelphia Belt Line Railroad franchise, if necessary. On the west side this belt-line privilege will run north only to Passyunk Avenue. The agreement also separates the Delaware Avenue line from the rest of the work, and affords the third railroad an opportunity to use part of the system without paying rental on all of it.

History and Evolution of Plan

In order to analyze the project more fully and discover why the particular streets chosen were selected it is necessary to go into the history of the improvement. The improvement had its inception in 1898, when an attempt was made to work out a plan for eliminating the grade crossings on the three lines across the city. Nothing constructive was settled at that time. In 1904 plans were prepared for elevating the two lines of the Pennsylvania to points east of Broad Street. Even at that time the city's Department of Wharves, Docks and Ferries was not in existence, and the possible unification of the waterfront did not figure in the changes contemplated—changes which, like those of 1898, failed to materialize.

The Bureau of Surveys, Department of Public Works, continued its studies, however, enlarging their scope, and in 1910 a plan was produced which would combine all of the through lines on one right-of-way in Twenty-fifth Street, crossing the city just north of the navy yard. This scheme contemplated elevating the Washington Avenue line and also the new line. It also recognized the possible benefit to both city and railroads of exchanges in waterfrontage. The railroads indicated willingness to enter into it in part.

Once again, in 1913, the matter was taken up, and this time it was pushed to an agreement. Instead of keeping the line in Twenty-fifth Street all the way from Washington Avenue to Girard Point, it was decided to swing west to Twenty-ninth Street at Point Breeze Avenue, thereby making the inclosed area larger and bringing the line nearer the large industries along the Schuylkill River. Most of the Twenty-ninth Street line will be on an embankment on private right-of-way, but because of the high cost of such right-of-way through the property of the Atlantic Refining Company, the line at this point will swing over to a viaduct in the street.

Broad Street Bridge

The 1910 scheme, again, contemplated keeping the line elevated all the way east to Broad Street, but this had the double objection that it would have placed an unsightly structure between League Island Park and the navy yard, and that, with the line only getting down to grade at Seventh Street, it would not have left room from there east for economical train-length terminals for the two railroads. The new plan, therefore, brings the line 600 ft. north of the navy yard at Broad Street, which thoroughfare is being carried over the tracks and brought down to grade at the entrance to the navy yard. The bridge, which is already well under way, will be a reinforced-concrete structure 360 ft. wide, with park spaces on the approaches and bridge itself to shut out the view of the railroad, and a belvidere will be built just north of it. Thus the railroad, instead of being an eyesore, becomes the justification for a fitting and artistic monument to mark the end of Philadelphia's principal thoroughfare and the entrance to the navy yard.

From this point east the new belt line is consigned to industrial purposes, and will therefore be kept on the ground. Delaware Avenue will be extended from Bigler to Hoyt Streets, and farther north it is already being widened. Only running tracks will be allowed in it, however. Plans have already been worked out for an entire rearrangement of the local freight yards just south of Washington Avenue. As a convenience for switching the existing line

Preliminary Estimate of Cost of South Philadelphia Improvement

Item	Total estimated cost	P. R. R.'s portion	B. & O. R. R.'s portion	City's portion
Washington Avenue Branch, P. B. & W. R. R.				
Washington Avenue Elevated Railroad:				
Thirtieth St. and Gray's Ferry Ave. to west side of Broad St. 2 tracks 30th to 25th Sts., 3 tracks 25th to 17th St., and 2 tracks 17th to Broad St.	$2,350,000	$1,175,000	....	$1,175,000
West side of Broad St. to 5th St. (2 tracks)	1,294,000	647,000	....	647,000
New freight station and elevated yard tracks between Broad and 17th Sts.	1,755,000	877,500	....	877,500
Car storage yard south of Washington Ave. between 18th and 19th Sts.	600,000	300,000	....	300,000
	$5,999,000	**$2,999,500**	**$.........**	**$2,999,500**
Delaware Extension, P. R. R.				
Two-track elevated railroad (steel viaduct) on 25th St. from Arsenal Bridge to McKean St., thence along Point Breeze Ave. to 29th St., thence embankment to Passyunk Ave.	$2,151,000	$1,075,500	$.........	$1,075,500
Three yard tracks from Magazine Lane to Penrose Ave. to replace tracks on Girard Point Branch	338,200	169,100	....	169,100
Girard Point Storage Co.'s tracks and elevation to connect with joint line	604,600	302,300	....	302,300
Two tracks on Delaware Ave. from Bigler to Swanson Sts., to be relaid with girder rails, paving Delaware Ave. from Reed to Queen Sts., purchasing Reed St. property and rebuilding yards and tracks to compensate for tracks removed from Delaware Ave., to permit widening of Reed and Front Sts. and Washington Ave.	734,000	367,000	....	367,000
New terminal yards between Broad St. and Delaware Ave., not including pier development, portion to be paid jointly by city and P. R. R. to replace present facilities and provide for dredging	1,500,000	750,000	....	750,000
	$5,327,800	**$2,663,900**	**$.........**	**$2,663,900**
Joint Four-Track Line, 29th St. and Passyunk Ave. to Bigler St and Delaware Ave.				
Four-track elevated railroad, 29th St. and Passyunk Ave. to Magazine Lane, thence embankment to Broad St., including Broad St. bridge and approaches	$3,280,300	$1,021,090	$1,021,090	$1,238,120
Four tracks at grade from east side Broad St. to Bigler St. and Delaware Ave.	647,000	194,100	194,100	258,800
Right-of-way for 6-track railroad from Magazine Lane to Bigler St.	228,000	45,600	45,600	136,800
Connecting Atlantic Refining Co.'s and City's Point Breeze gas works' sidings and tracks to elevated joint line	100,000	30,000	30,000	40,000
	$4,255,300	**$1,290,790**	**$1,290,790**	**$1,673,720**
Schuylkill River East Side R. R., B. & O. R. R.				
Two-track railroad on embankment from Schuylkill Ave. to Wolf St., thence on Wolf St. to 29th St. and Passyunk Ave.	$476,000	$.........	$238,000	$238,000
Two-track railroad on Delaware Ave. from Bigler to Vandalia Sts.	130,000	....	65,000	65,000
	$606,000	**$.........**	**$303,000**	**$303,000**
Total cost of work shared by Department of Public Works	**$16,188,100**	**$6,954,190**	**$1,593,790**	**$7,640,120**
Additional yard facilities required by P. R. R., Reed St. and Washington Ave.	$273,000	$273,000	$.........	$.........
Additional facilities to be constructed entirely at P. R. R.'s expense	2,000,000	2,000,000	....	....
To replace waterfront facilities on property owned by P. R. R. south of Hoyt St.	1,300,000	1,300,000	....	....
	$3,573,000	**$3,573,000**	**$.........**	**$.........**
Additional yard facilities required by B. & O. R. R.—new terminal yards between Broad St. and Delaware River (approximate estimate)	**$1,500,000**	**$.........**	**$1,500,000**	**$.........**
Purchase by city of Section 1—piers, tracks, etc., Delaware Ave. to pierhead line and Bigler St. to Hoyt St. (approximate estimate). (Department of Wharves, Docks and Ferries)	$2,300,000	$.........	$.........	$2,300,000
Purchase by city of piers, tracks, etc., Delaware Ave. to pierhead line and Jackson and McKean Sts. (approximate estimate)	1,000,000	....	....	1,000,000
	$3,300,000	**$.........**	**$.........**	**$3,300,000**

Pennsylvania		*Baltimore & Ohio*		*City of Philadelphia*	
Total cost to Pennsylvania	$10,527,190	Total cost to Baltimore & Ohio	$3,093,790	Cost to Dept. of Public Works	$7,640,120
Less credit by city, present waterfront property	*2,300,000*	Less credit by city, present waterfront property	*1,000,000*	Cost to Dept. of Wharves, Docks and Ferries	3,300,000
Net cost to Pennsylvania	**$8,227,190**	Net cost to Baltimore & Ohio	**$2,093,790**	Total cost to city	**$10,940,120**

Total cost of work .... **$24,561,100** of the Baltimore & Ohio in Vandalia Street from Oregon Avenue to Delaware Avenue may remain, and may be extended as a single-track line, at the railroad's expense, to a junction with the new line south of Hoyt Street.

In general the details of the improvement, such as the railroad terminal yards, the exact location of the main tracks and the design of the bridges and elevated structures have not yet been worked out. As already stated, however, the question of main trackage was carefully worked out in the agreement itself to protect the interests of both city and railroads, and it is definitely stipulated that four tracks shall be laid, and operated as a joint four-track line, although the Pennsylvania and the Baltimore & Ohio will each own and maintain two of the tracks.

FIRST CONSTRUCTION ON SOUTH PHILADELPHIA WORK, BROAD STREET BRIDGE

ESTIMATED COST

The accompanying table shows the complexity of the distribution of the expense of the improvement, as well as the estimated cost of the entire project and its component parts. Except for the water terminals, the work in which only one of the railways is concerned will be paid for half and half by railroad and city. Where both railroads are involved they each pay 30 per cent and the city pays 40 per cent, but in the acquistion of right-of-way from Passyunk Avenue to Delaware Avenue, because the city acquires space for the two future tracks to be laid under the franchise of the Philadelphia Belt Line Railroad, it assumes 60 per cent and the railroads pay only 20 per cent each. The water terminals surrendered by the railroads are treated as separate propositions, and the city buys them outright at appraised values; while the railroads pay the entire costs of the facilities they expect to build on their new terminal sites. In general the sense of the agreement is joint participation in the replacement of all existing facilities, and assumption of the entire cost by the beneficary of any new facilities.

As the general agreement was executed in July, 1913, most of the foregoing information has been public property for two years. A knowledge of it is necessary, however, to understand the problems in which the Bureau of Surveys and the engineering departments of the railroads are involved. The Bureau of Surveys is at present making a minute appraisal of the property affected. The territory is divided into convenient sections a quarter of a mile or so long, and every item of railroad property within the district is noted in the field and recorded in a table on a large-scale map of the district. Ties, rails, switches, signs, signals and poles are taken account of, and in the case of buildings to be replaced the usable volume governs. Where the building code requires a more expensive type of construction than that existing, the city pays a proportion of the difference in cost. Three men from the office of assistant engineer of grade crossings, Bureau of Surveys, have been engaged in the appraisal work for more than three months, and up to middle of August had covered the territory along Delaware Avenue from Christian Street to the Greenwich coal terminal.

PERSONNEL

All plans and specifications of the railroads are subject to the approval of the director of the Department of Public Works, and the chief engineer of the Bureau of Surveys. The assistant engineer of the Grade Crossing Division has general supervision of the preparation of plans and specifications, the letting of contracts and the construction work itself. Morris L. Cooke is director of the Department of Public Works; George S. Webster is chief engineer and surveyor of the Bureau of Surveys; George E. Datesman is principal assistant engineer and J. W. Phillips is assistant engineer of grade crossings. For the Pennsylvania Railroad, A. C. Shand, chief engineer, is represented by Edward B. Temple, assistant chief engineer, and H. A. Lane, assistant engineer of surveys, acting for F. L. Stuart, chief engineer, represents the Baltimore & Ohio Railroad. Arthur McMullen Company of New York City has the contract for the bridge and approaches already under construction at the foot of Broad Street.

Small Granite Blocks Laid on Cement-Sand Cushion

Paving at Mail Service Building, New York City, Was Then Flushed, Turning Cushion Into Concrete—Asphalt for Joints

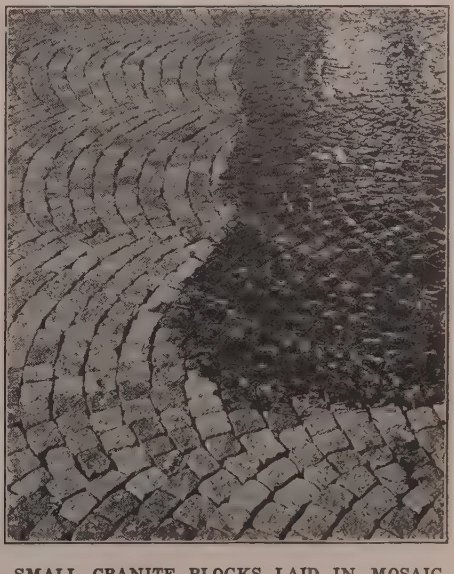
LACK of native workmen skilled in the laying of small, machine-cut granite blocks in the mosaic pattern characteristic of Durax pavement necessitated the employment of foreign laborers on the driveways flanking Forty-fifth and Forty-sixth Streets in the Mail Service Building, between Park and Lexington Avenues, New York City. The methods followed in European countries where this type of pavement has been used extensively were followed by the Metropolitan Paving Company on the New York work, which has just been completed. The small blocks were laid on a concrete base, with a cushion of dry sand and cement, which was flushed with water and allowed to set. Then the joints were filled with asphalt.

Perhaps the oldest paving of the kind in this country is that laid two years ago at the Brooklyn Navy Yard, where a cushion of limestone chips was used. This work was described in the Engineering Record of Aug. 16, 1913, page 181. It is said that a block of this paving will be laid soon on Second Avenue as an experiment by the city of New York.

PAVING PROCESS OUTLINED

The concrete base for this paving is laid in the usual way. On it, in advance of laying the blocks at the Mail Service Building, was spread 1 to 1½ in. of a dry 1 : 2 sand-cement mixture. In this, using a paver's hammer, the workmen embedded the granite blocks. At the Brooklyn Navy Yard these were laid, except for a small patch, in straight courses. The more approved way, used abroad and in the Mail Service Building, is to lay the blocks on intersecting arcs of circles, forming a fan-shaped mosaic. The blocks vary in size and are not perfect cubes, yet it is rare that the experienced workman has to lay one aside; selections of the right block from the pile are made quickly and accurately by eye. A skilled worker can lay 20 sq. yd. of these blocks in an 8-hr. day.

As soon as the section of blocks is laid it is sprinkled thinly with fine gravel. This



SMALL GRANITE BLOCKS LAID IN MOSAIC PATTERN IS EUROPEAN PRACTICE is broomed into the joints, filling them about three-quarters full. A 5-ton roller is next used, which leaves the work with a surprisingly even surface. The pavement is then flushed with a hose, washing about one-third of the gravel out of the joints, and thoroughly wetting the cement-sand cushion. As soon as this cushion has taken a firm set a thin mix of hot asphalt is poured over the pavement and broomed into the joints. Some asphalt remains on the surface of the pavement, but soon wears off.

DURABLE SURFACE FORMED

This pavement was laid to carry heavy traffic. The blocks make an even surface with a low coefficient of rolling friction, but having, owing to the crystalline structure of the granite, a high coefficient of sliding friction.

Since the Durax pavement at the Brooklyn Navy Yard was put down, others have been laid in Louisville, Ky.; Danville, Va.; Salisbury, N. C.; Cleveland and Columbus, Ohio.

St. Louis Gives Object Lessons of Water Waste

TEN FAUCETS, opened to give streams varying from ⅝ to 1/32 in. in diameter, were tapped into a large main and the arrangement was shown in the office of the St. Louis Water Department to indicate to patrons the rate of flow. The accompanying table gave the following amounts wasted and the cost at 9 cents per 1000 gal. The smaller streams represent an ordinary leak and the larger ones careless or willful waste due to allowing faucets to remain open.

WATER WASTE FROM FAUCETS OF DIFFERENT SIZES

Size of stream, in.	Flow, gal. per min.	Daily cost, cents
5/8	4.86	63.0
1/2	4.16	54.0
7/16	3.24	42.0
3/8	1.90	24.7
5/16	1.50	19.5
1/4	1.29	16.7
3/16	1.10	14.2
1/8	0.86	11.2
1/16	0.44	5.7
1/32	0.13	1.7

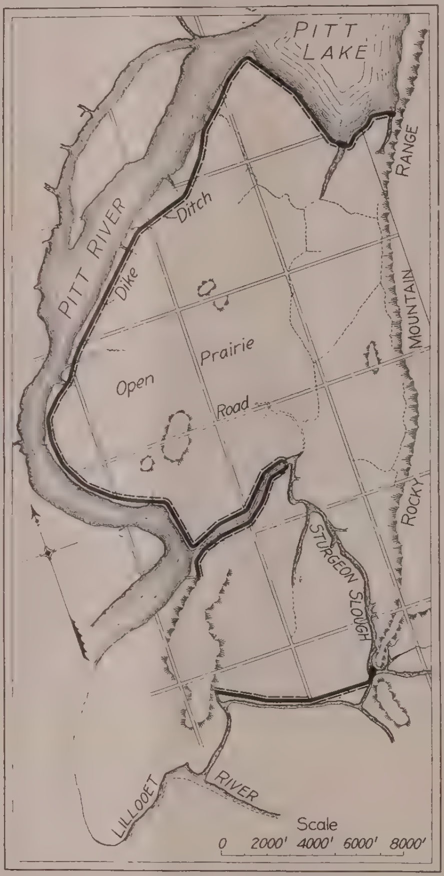
THE FRENCH GOVERNMENT on Aug. 3 is reported to have made inquiry in the Chicago lumber market for 6,000,000 white oak railway ties, calling for over 173,000,000 ft. board measure of timber. This order, if placed, would almost exhaust the stock of white oak for ties in this country. This wood is specified because of its long life, untreated. The supply of creosote, it is said, has been so reduced by the blockade of Germany that treated ties in this quantity are not to be had.

Simple Construction Reclaims 7000 Acres of Rich Land at Low Cost

Dike Prevents Periodic Flooding, While Flood-Gates Normally and Pumping Plant in Times of High Water Handle Rain and Seepage Water

By H. M. BURWELL, C.E.
Of Hermon & Burwell, Vancouver, B. C.

PERIODIC flooding of 7000 acres of rich meadow land has been prevented and its use for agricultural purposes made possible by construction costing only $109,000. This territory, known as Pitt Meadows, is situated along the Pitt River and Pitt Lake in the lower Fraser River Valley, about 20 miles east of the city of Vancouver, B. C.



DIKE PREVENTS HIGH WATER FROM BACKING UP AND OVERFLOWING MEADOWS

CHARACTER OF PROJECT

The site of the meadows was, no doubt, originally an arm of the sea, which has been filled up by sediment carried down by the Fraser River. Pitt River is a large, deep-water channel connecting Pitt Lake with the Fraser River. All are tidal waters, having a daily average rise and fall of about 3 ft.

During the flood season of the Fraser River the water is backed up over the meadows for a period of from two to two and a half months, in May, June and July, which made necessary the construction of a dike around the land to prevent its flooding, flood-gates to drain off the water at low tides, and a pumping plant to relieve it from the accumulated rainfall and seepage during the period of high water.

The land is a rich alluvial deposit with a depth of about 2 ft. of clay loam on the surface, under which is a depth of about 10 ft. of yellowish clay, and under this, in places, as much as 1200 ft. of river silt and clay, ascertained by recent boring operations.

RECLAMATION WORK

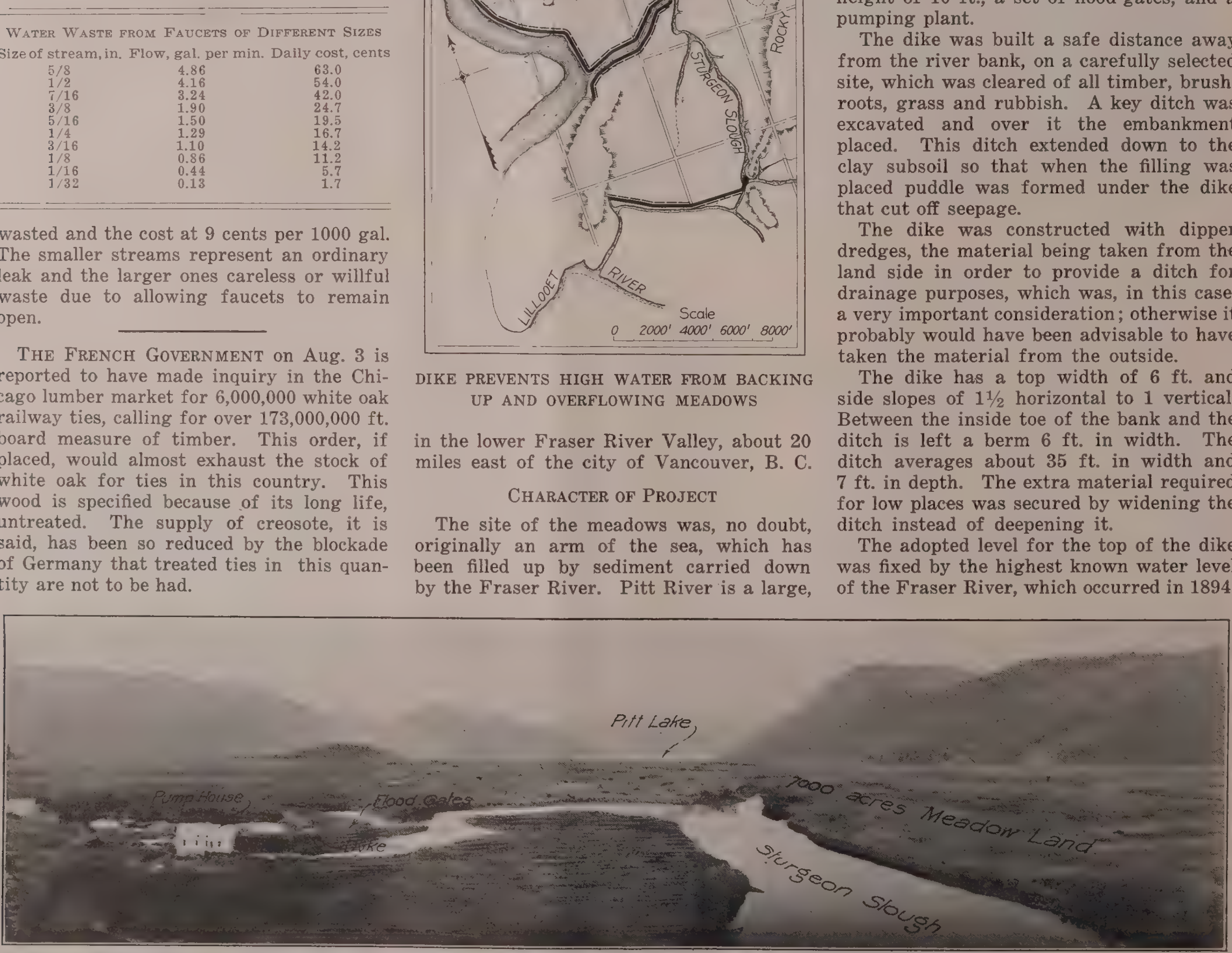
The reclamation work consisted principally of 11 miles of dike, with an average height of 10 ft., a set of flood-gates, and a pumping plant.

The dike was built a safe distance away from the river bank, on a carefully selected site, which was cleared of all timber, brush, roots, grass and rubbish. A key ditch was excavated and over it the embankment placed. This ditch extended down to the clay subsoil so that when the filling was placed puddle was formed under the dike that cut off seepage.

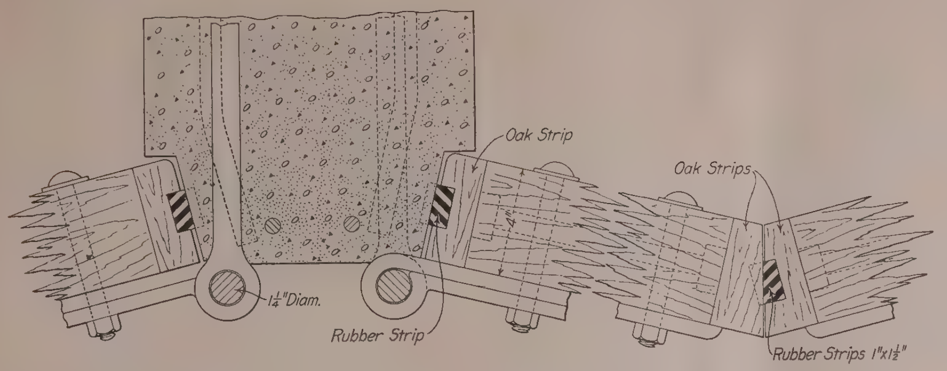
The dike was constructed with dipper dredges, the material being taken from the land side in order to provide a ditch for drainage purposes, which was, in this case, a very important consideration; otherwise it probably would have been advisable to have taken the material from the outside.

The dike has a top width of 6 ft. and side slopes of 1½ horizontal to 1 vertical. Between the inside toe of the bank and the ditch is left a berm 6 ft. in width. The ditch averages about 35 ft. in width and 7 ft. in depth. The extra material required for low places was secured by widening the ditch instead of deepening it.

The adopted level for the top of the dike was fixed by the highest known water level of the Fraser River, which occurred in 1894.



FERTILE SEDIMENT DEPOSIT MADE AVAILABLE FOR FARMING PURPOSES BY INEXPENSIVE CONSTRUCTION



FLOOD-GATES OPEN AND CLOSE ACCORDING TO RISE OR FALL OF TIDE

The finished top being 2 ft. above this level, gives it an average height above the land of about 10 ft.

PILES DRIVEN TO RETAIN BANKS ACROSS TWO DEEP SLOUGHS

Across two deep sloughs which intersect these meadows, the dike was constructed in a manner similar to the rest of the work, except that in addition to the earth bank, a quantity of brush and a row of closely driven piles were placed to retain the slopes and protect the dike against the wave action of the adjoining ponds.

One of these sloughs, known as Sturgeon Slough, extends through the central part of the meadows. It has a total length of about 3 miles, a width of from 100 to 150 ft. and a depth of about 20 ft. It was thought advisable to dike around this slough for a distance of 1 mile inland from its outlet, thereby keeping open a deep waterway into the central portion of the reclaimed land.

Along the portion of the dike adjoining Pitt Lake a protection banquette outside of the dike was constructed of surface soil and sods to protect the dike from the wave action of the lake and moving driftwood. This bank extends to within 3 to 4 ft. of the top of the dike, and has a width of from 12 to 15 ft., the material being placed by a dipper dredge operated during high water along the outside of the dike.

In addition to this protection work, fences were placed outside of it by all exposed points. These were built by driving cedar piles on 8-ft. centers, to which were spiked 1½-in. fir lumber, leaving 2-in. openings between the boards.

The flood-gates are located at a point near the crossing at Sturgeon Slough, this being the most central place available. They are directly connected with the slough channel, which acts as an equalizing reservoir about 35 acres in area, giving a quicker discharge than could otherwise be had if they were fed only from the ditch.

The flood sluiceway has four 5 x 8-ft. openings, and is constructed of reinforced concrete, except the floor, which is built of fir timber. As this floor will always be covered with water the timber will be durable and satisfactory and the cost much lower than for concrete. The gates are hung at a slight angle, and open and close automatically with the fall and rise of the tides.

PUMPING PLANT

The pumping plant is located near the flood-gates, and consists of one 30-in., double-suction, horizontal, centrifugal pump having two suction inlets, each 22 in. in diameter at the pump, tapering to 24 in. in diameter at the suction end. The 30-in. discharge pipe is also enlarged to 36 in. where it passes through the dike.

This pump is driven by a 100-hp. Westinghouse motor, transmitting the power to the pump shaft through a Reynolds silent chain drive. It is set on a concrete foundation, resting on a group of piles, at a level sufficiently low to discharge under water at all stages during the flood period.

The maximum lift is 9 ft. and the capacity of the pump is 25,000 gal. per minute, which, estimated from all the available data, is sufficient to provide for the rainfall over the whole drainage area plus the seepage during the months mentioned.

The land was granted by the Dominion Government to the Pitt Meadows Land Company in the name of W. R. Rannie, at a nominal price per acre, and with the provision that the whole reclamation work would be completed before May, 1913. The work was performed, under contract, by Messrs. W. A. Rannie and J. W. Pile of Vancouver, B. C., at a total cost of $109,000 or about $15 per acre.

The unit prices were: Dikes, 14½ cents per cubic yard; dams, 24 cents per cubic yard; protection banquette, 10 cents per cubic yard; clearing, $50 per acre; grubbing, $75 per acre; piling in place, 25 cents per foot, and lumber in place, $24 per foot b. m.; flood-gates complete, $575; pumping station, $9,689.

The whole work was performed under the direct supervision of the writer, with H. St. J. Montizambert acting as assistant.

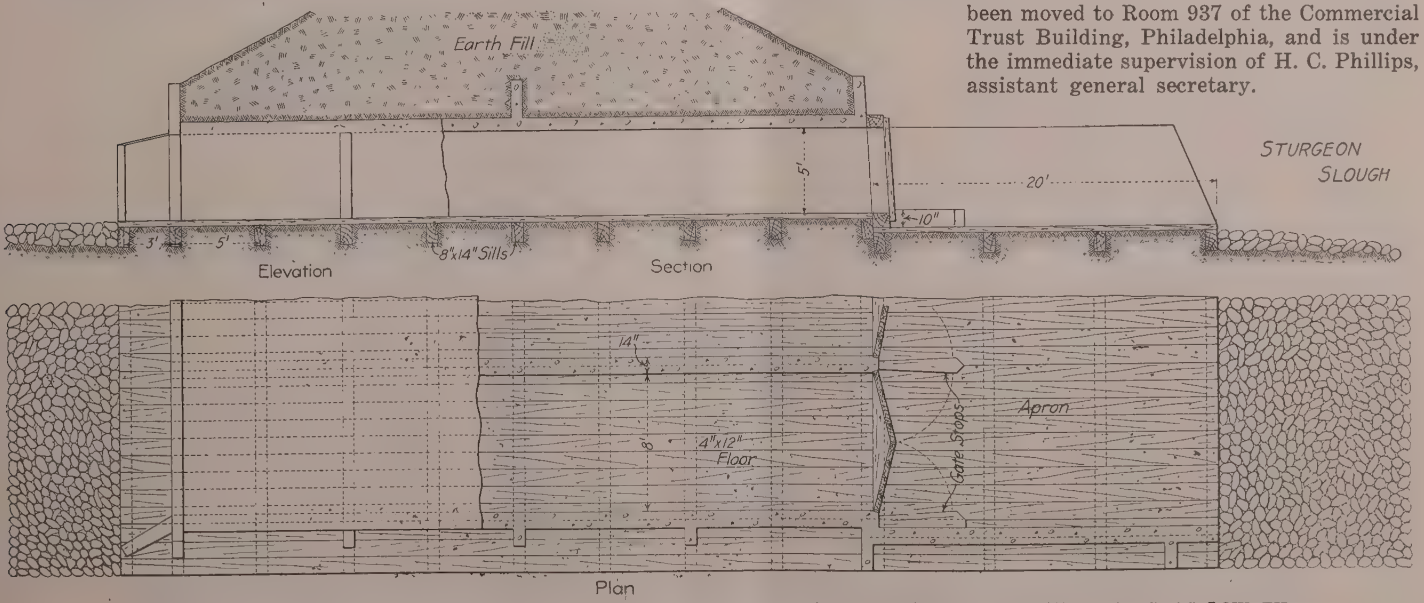
Recent Developments in Federal Evaluation of Carriers

THE Interstate Commerce Commission has assigned Sept. 30 and Oct. 1 and 2 for the hearing of oral argument on some of the fundamental principles involved in the evaluation of common carriers, states a bulletin issued by Thomas W. Hulme, general secretary of the Presidents' Conference Committee. The committee of counsel has filed a brief with the commission on behalf of the Presidents' Conference Committee.

Order 19, issued by the Division of Valuation May 21, requires from certain railroad companies information with reference to the purchase of telegraph and telephone materials and compensation paid for telegraph labor. Order 20, dated May 13 and issued Aug. 24, requires the preparation of a statement and chart showing the carrier's corporate history, including that of all predecessor companies. The order requires every carrier upon whom it is served to furnish the information within six months after such service.

The carriers' organization is giving special consideration to the compilation of rulings made by the Division of Valuation in connection with orders it has issued; also with reference to the treatment of overhead bridges, industrial side tracks, and the methods by which "condition per cent" is being determined and noted.

The office of the general secretary has been moved to Room 937 of the Commercial Trust Building, Philadelphia, and is under the immediate supervision of H. C. Phillips, assistant general secretary.



SLUICEWAY CONSTRUCTED OF REINFORCED-CONCRETE WITH TIMBER FLOOR DRAINS TRACT AT PERIODS OF LOW TIDE

Captain Bernhard Urges Development of Inland Water Transportation

Disputes Assertion That It Is Not Needed—Attributes Its Decline Mainly to "Rate-Anarchism," Obsolete Boats and Poor River Terminals

DISAGREEING entirely with the opinion expressed by Col. W. W. Harts, Corp of Engineers, U. S. A., in his paper on "Rivers and Railroads in the United States," presented before the American Society of Civil Engineers Feb. 3, that river development for transportation purposes has gone too far in the United States, and that inland water transportation will not be needed until some time in the future, Capt. John H. Bernhard, discussing the paper at length in the August "Proceedings" of the society, page 1539, avers that on the contrary not nearly enough money has been spent on these inland streams and that the trouble with water transportation in the United States is merely that it is as yet unappreciated. The present decline in the traffic he attributes to "rate-anarchism," poor river terminals, obsolete boats, the absence of proper connecting links between existing routes, and poor navigation laws and regulations, Government assistance, banking facilities and insurance rates. He deplores the present "pork-barrel" method of carrying out waterway improvements, and urges the saner policy of having each project weighed on its individual merits and, when adopted, pushed without interruption to completion. He advocates the creation of a Federal waterways department headed by a cabinet minister, and would have the commercial value of a project passed upon by water-transportation experts instead of by army engineers not specially trained for such problems. He urges an educational campaign for the building of inland water terminals. He holds that water transportation can be both cheaper and faster than rail transportation, and offers numerous figures in support of his contention. In illustrating some of his points he describes the trip made by his 1000-ton barge from New Orleans to St. Paul a year ago, and also gives some information about the line of barges to be put on the Mississippi River by the company which he has organized.

The following notes are taken from Captain Bernhard's discussion. As the discussion occupies 48 pages of the "Proceedings," it is impossible in the limited space available here to bring out all of the phases of the subject covered by him.

"RATE-ANARCHISM"

The rate situation in the United States is based on two faulty foundations: (1) "Charge what the traffic will stand"; and (2) "Any rate to meet water competition." In the preliminary report just published by the Interstate Commerce Commission for the fiscal year ended June 30, 1914, the average receipts were 0.733 cents per ton mile. The rail distance between New Orleans and St. Louis is 700 miles, which would give, as the average charge, based on the above figure, $5.13; yet the following are some of the rates in effect between those two cities: Bridge material, $3.50; cement, $2.50; flour, $2.80; grain, $1.80; lumber, $4; vehicles, $5. The railroads haul freight to river points at a loss, and then recoup themselves by exorbitant charges to off-river points.

First-class freight is shipped from New Orleans to Memphis, 396 miles, for $9 per ton, or 22.8 mills per ton-mile. To ship the same commodities from New Orleans to Amite, La., 68 miles, the cost is $10.40 per ton, or 153 mills per ton-mile. Although the distance from Birmingham to Tuscaloosa, Ala., is about one-eighth of that from Birmingham to New Orleans, the average freight rate is about one-half of that to New Orleans; but Tuscaloosa is on a navigable water, by which New Orleans, Mobile or other cities may be reached.

Flour for domestic use moves from St. Paul to New Orleans for $5.50 per ton; from New Orleans to St. Paul (same routing), for $9.80 per ton. The higher rates are up stream. Had this flour been moved by water, and had it been meant for export, it would have been more cheaply loaded from barge to ship than to warehouses in the city; therefore the railroads have a third rate, which is the "export rate," and this, from St. Paul to New Orleans, is $3.90.

OBSOLETE BOATS

The second reason for the decline of water transportation is the obsoleteness of the river craft, as shown by comparative data between a modern self-propelled steel barge which operated on the Mississippi River between New Orleans and St. Paul, and the prevailing type of Mississippi River boats. The 1000-ton, self-propelled, twin screw, shallow-draft steel barge, operated by two gas-producer engines, had a crew of seven men and a speed of 8 miles per hour when loaded with only 1000 tons of cargo. It consumed fuel at the rate of 30 cents per hour. Its cost complete was $32,000. The average cost of a Mississippi River boat of like capacity is from $60,000 to $70,000. Such a boat has an average crew of 54. Insurance on the barge was 4 per cent for fire and marine; on the steamboat it is from 12 to 15 per cent. Fuel consumption on the barge was 30 cents per hour, while on the steamboat it is $4 per hour, both boats traveling at a speed of 8 miles per hour. The total cost of operation of the barge, including overhead expenses, was $2,100 per month; on the steamboat it is $8,100 per month.

Another trouble on our alluvial streams is the so-called "aids to navigation." Great difficulties are caused by the tardy adjustment of the Government channel lights, which adjustment, as a rule, is so much behind the actual changing of the channel that the Government marks do not show where the channel is, but where it was.

BANKING AND INSURANCE HANDICAPS

Another obstruction to economical navigation is caused by the total absence of banking accommodations. Bills of lading are frequently considered as bank securities unless they happen to be for freight on inland water craft, then the bank refuses them. With a blind mule or an automobile as security, one can get at least a certain percentage of its value as a loan, but with the cheapest tool of transportation—a river boat—one might well have to sift the entire United States in order to find a single man or bank willing to furnish reasonable banking accommodations.

Another important obstacle is the insurance rates. A barge carried from New Orleans to St. Paul, 1921 miles, 90 tons of coffee, on which the freight rate of $4.25 per ton was paid. The insurance rate was $2.70 per ton and the terminal charges were 43 cents, leaving a net total of $1.12 for carrying the ton 1921 miles. This rate of insurance is actually several times larger than insurance on the same commodity from Brazil to St. Paul, provided it is moved by rail from New Orleans to St. Paul.

There are three reasons for this flagrant injustice: (1) The small inland waterborne traffic makes it no fair average risk; the laws of average are hardly applicable for this limited movement. (2) The insurance companies, like most of the people in the United States, do not take water transportation seriously; they do not care to foster it, because they only see possible losses, and not even the promise of a future. (3) Most of the insurance companies have invested their securities in railroad bonds, which circumstance seems to strengthen their belief that water transportation should not be taken seriously.

INEFFICIENT TERMINALS

The greatest handicap to inland navigation in the United States to-day, however, is the absence of terminals. This is especially true of the Mississippi River, where we are still content with mud levees, slippery and cumbersome. So important is the terminal question that it may be said that the problem of inland transportation is more a shore than a water problem. Almost invariably the shore expenses are higher than the actual cost of transportation from harbor to harbor. With the present river terminals, the height of inefficiency seems to have been reached. The shipper must carry his freight by wagon over poor roads, move it somehow down a poorly paved and usually very steep bank, laboriously unload it by hand, roll it to the edge of a muddy levee, and watch it until the steamboat may arrive, when it is carried piece by piece and stowed away under the towering superstructure of an American steamboat, amid a forest of deck supports; and the process must be reversed at the other end of the voyage. The only exception to these conditions is the city of New Orleans, where covered sheds are provided, and where mechanical loading and unloading devices are now tried.

The excessive terminal cost often offsets the advantage of the low river rate. There is no port in the Mississippi valley at which freight can be transferred directly from car to boat, or vice versa, except with a heavy shifting arbitrary, or by an added labor cost equal to from 10 to 50 cents per ton. For shipments originating or consigned, locally, drayage cost and the inconvenience of the present landings are such that each alone is sufficient to divert to rail routings a large volume of freight which otherwise would move by water at a distinct saving to the shipper. These river terminals lack even the most commonplace necessities, such as decent streets, trolley-car connections, telephones and the telegraph.

TRIAL BARGE TRIP UP THE MISSISSIPPI

The 1000-ton self-propelled barge which went to St. Paul from New Orleans in August, 1914, brought this matter of high terminal expenses forcibly to light. The New Orleans freight was received, watched and loaded for a total of 26½ cents per ton. At Jeffries, La., 544.6 tons of lumber took 91 hr. for loading. The entire cost of loading and unloading to the shipper, together with the time loss to the barge, was $807.35, as compared with the transportation of the entire lumber cargo for $998.37—or $1.80 per ton to carry the lumber 1000 miles and $1.46 to carry it to and from the barge. With any proper semblance of an opportunity this lumber should have been loaded in 12 hr., saving 79 hr. or $305. The total cost of loading and unloading the barge on the entire trip was $1,733.12, or 63 per cent of the gross freight receipts.

The quarantine regulations which have to be contended with are worthy of a few remarks. This steel barge, which was in New Orleans only six hours, during the day time, and had been officially declared "absolutely rat-proof," was frequently detained by the various health officials along the route until the very end of its journey. At St. Paul, 1921 miles from New Orleans, 35 days after its departure, it received its last health inspector, although it had lain five days off Jeffries, three at St. Louis, and shorter periods at various other places, had been officially fumigated, and had had hundreds of visitors.

The barge left July 6 and returned Aug. 29, being gone a total of 54 days and 8 hr., including loading and unloading; and during that time it covered 3843 miles, spending 240 hr. and 45 min. in loading and unloading 1183 tons. She lost 8 hr. and 4 min. on account of engine trouble, was grounded for 174 hr. and 10 min., or waiting for the pilot to ascertain the location of the channel.

The barge carried coffee, rice, sugar, cement, molasses, lumber, flour, paper and chemicals. Out of the total of 1,921,000 ton-miles capacity each way it delivered 1,066,986 ton-miles upstream and 183,181 downstream, or a total for the round trip of 32 per cent of the barge's capacity. The total gross receipts were $2,762.57, or 2.21 mills per ton-mile; the same freight moved by rail would have cost $4,932.98.

What the Trip Showed

The total expenses of the barge were high, and some items were out of all proportion on account of the lack of organization and other consequences of this "isolated" trip. For instance, the extra pilots, needed because the crew was totally unfamiliar with the routes, received for this single trip in wages $1,014.13. Heavy expenses incurred through slow loading were to a large extent caused by the fact that this was an isolated trip. Under usual conditions, with a regular service and more boats than one to carry all the overhead and administration charges, the total expenses would have been less than $3,500, but the total expenses for this 3842-mile journey were $5,740.42, or a total of 1.65 mills per ton-mile of carrying capacity.

Had the barge been fully loaded both ways the gross receipts would have been $8,491, at a rate of 2.21 mills per ton-mile, yielding a profit of $2,750.78 even under the adverse conditions of this single trip—and this notwithstanding the fact that, in mills per ton-mile, the freight rate of the barge was 37 per cent of the rail rate.

With the exception of some through freight, transportation by water is faster than by rail. A barge entirely inadaptable for Mississippi River service, having only 150 hp. for 1000 tons carrying capacity, and spending 18 days for loading and unloading and other delays along the river, on account of the poor terminals and channel lights, averaged on its round trip, inclusive of all delay, more than 72 miles per day. What railroads to-day can show such a speed in their average shipments?

Water Transportation Cheaper Than That by Rail

It can be shown that water transportation can be made cheaper than railroad transportation. From the Pacific Coast through the Panama Canal to the Atlantic Coast, inclusive of canal tolls, the average rate is $6 per ton. The average rail rate from coast to coast, in a more direct line, not paying canal tolls, is $22 per ton. Nowhere in the world are coal and ore moved more cheaply than on the Great Lakes, where the average is 0.4 mill per ton-mile. General package freight on the Great Lakes would still be handled at a great advantage over the rail rate were it not for the fact that water competition has been throttled by the railroads. As to rates on canals, with the old Erie Canal fallen into disuse, the average rail rate between Buffalo and New York paralleling it is 4½ mills per ton-mile, while the average cost in the United States is 7½ mills per ton-mile. The old canal is hardly a ditch, yet to-day freight is moving through it, with the same old methods of a century ago, at a charge of 3 mills per ton-mile. The New York State Barge Canal will reduce the cost considerably more.

Can boats be built that will give as low rates on the rivers? Most decidedly, yes. The writer knows of no more difficult route in the United States than that from Tuscaloosa, Ala., to New Orleans. To-day barges are movng coal at a cost of ¾ mill per ton-mile over this route and returning empty. Just such a barge, entirely unfit for the Mississippi service, was used by the writer in August, 1914, the trip to New Orleans to St. Paul and back.

Proposed Mississippi Barge Line

To illustrate how cheap and profitable is inland navigation in general, and Mississippi navigation in particular, the writer gives some figures which he compiled recently for a group of financiers, who, on the strength of them, have agreed to furnish the needed capital of $5,000,000 for the Inland Navigation Company. This company, by May, 1917, will place on the lower Mississippi, between New Orleans and St. Louis, five barges (one reserve barge), each of 3000 tons carrying capacity and an upstream speed of 15 miles per hour, so that a schedule may be maintained of a 3000-ton barge leaving New Orleans and St. Louis every Tuesday, Thursday and Saturday.

These barges will have a maximum draft of 7 ft. and will be propelled by four propellers. The power will be furnished by four gas-producer engines, with a total of 2400 hp. The barges, entirely of steel, 310 ft. long, of 56-ft. beam and 9-ft. depth, will have a weatherproof cargo box. Each barge will be equipped with wireless apparatus, motor launch, watertight bulkheads, searchlights and many important factors of economy. Each will be manned by 21 men, with a combined monthly payroll of $1,970.

The complete cost of each barge will be $312,000. The estimated cost of operation based on an open season of 8½ months to St. Louis, 9 to Cairo, 10 to Memphis and 12 to Vicksburg, is $56,160 per year. The total fixed charges are $280,800 per year. With a working capital of $240,000 a total needed capital of $1,800,000 for five barges is needed. To this should be added auxiliaries, such as fast and powerful inspection tugs, each costing approximately $45,000, three of which are needed; two fast inspection launches, at a total cost of $15,000, and a number of smaller launches. There will be wireless stations at Memphis, St. Louis and New Orleans, the total cost of these stations to be $40,000. This, with $10,000 for office equipment and extras, makes $200,000 for extra equipment, or a total of $2,000,000.

Time and Cost of Trip

In theory the barge will make the trip from New Orleans to St. Louis in 80 hr. running time, but in practice, when fog, wind, engine troubles and grounding play an important part, an upstream trip of 4½ days should be estimated. The loading and unloading of each terminal should not take more than 12 hr., so that the round trip may safely be based on 9 days, estimating a speed for the downstream trip at an average of 17½ miles per hour. On this basis the five barges will make 187 trips per year, so that the fixed charges with the profits amount to a total of $3,640.60 per trip.

The expenses per trip figure as follows:

Fixed charges, including interest and profits	$3,640.60
Wages, including insurance	639.00
Subsistence	102.47
Fuel	840.00
Supplies	400.00
Extras, at 3 per cent	291.00
Total	$5,913.07

Or, in round numbers, $6,000.

With the barge fully loaded on each trip, freight could be moved from New Orleans to St. Louis for $1 per ton, which would give a yearly dividend of 26 per cent and establish a 100-per cent sinking fund within 12 years. It seems safe to estimate that the barges will soon be loaded to 80 per cent of their capacity, or $1.25 per ton from New Orleans to St. Louis. The rail rates are such that during the winter the company should be prepared to stand an estimated loss of $180,000, because, in many cases, the rail rate from Vicksburg, Memphis or Cairo, East St. Louis is more than the water rate from New Orleans to St. Louis. This makes an additional total charge of 17½ cents per ton over the entire year, and the administration, soliciting and advertising is estimated at about 7½ cents per ton. Thus, outside of loading and unloading, or switching charges, the total rate per ton from New Orleans to St. Louis should be $1.50 per ton.

Special Terminal Barges

The cost of loading and unloading includes only the removal of freight to and from the barge. The value of the barge is $32.22 per hour, so that every hour's delay means a tax of 1.34 cents per ton, and economical transport with the greatest despatch is of the utmost importance. It is the intent to make stops only at cities where there are proper modern terminal facilities, or which, either as a community or through individual shippers, have signed for sufficient freight to and from to justify the company in establishing its own river terminals at such cities. The loading and unloading are to be taken care of by a separate company.

It is proposed to build some of these terminals as floating terminals, so that they may be removed. The deck of such a terminal can always be at the same height as that of the barge deck; and the terminal is to be connected by tracks, running over the roof of the terminal barge cargo box, over a hinged apron, to the belt railway, if there is such, or otherwise to the various railroad tracks. This floating terminal collects and disburses the freight, and care will be taken that it is ready for loading on the arrival of the barge, and also that preparations are made to have the loading and unloading proceed simultaneously. Such a terminal will always have a little more than twice the capacity of the barge which it serves; the terminals will be equipped with wireless apparatus, two 10-ton traveling cranes with 40-ft. booms, and also telphers, conveyors and electric trucks.

The main deck of the terminal barge will connect directly with the street by a roadway 40 ft. wide, running through the center of the barge from end to end. The height of the transfer barge will be regulated by water pumped out or let in, as necessary, so that the transfer and transportation barges will always be at the same height during the loading and unloading.

It is assumed that the total crew on shore will necessitate a combined yearly payroll of $125,000, plus insurance, or about 14 cents per ton received or delivered. The transfer barge complete with all its appliances will cost $300,000; and interest, depreciation, insurance, repairs and harbor dues will amount to 15 per cent per year, or 4½ cents per ton. Thus the total shore expenses, outside of switching charges or car hire, will be 20 cents per ton, and estimating the profits at 20 per cent the charge would be 25 cents per ton.

Hence, the total charges from New Orleans to St. Louis are 10 cents for switching charge and car rental, 25 cents for loading, $1.50 for transportation, 25 cents for unloading and 20 for car hire and switching charges in St. Louis, or $2.30 per ton. This charge will be reduced to $1.92 as soon as the Interstate Commerce Commission has readjusted the present switching and rate arbitraries. This rate covers receiving in cars at warehouse and delivery at warehouse of consumer. When received and delivered at the river terminals the charge will be reduced to $1.82 per ton, and if it is guaranteed that the barge will be loaded to full capacity the charge will be reduced to $1.45 per ton. This latter should be the ultimate and total charge, and it is the company's aim to be able to make a rate of 1.2 mills, water distance, or 2 mills per ton-mile, rail distance.

NOT SMALLER, BUT SANER, EXPENDITURES ARE NEEDED

The writer does not believe that we need to look forward to smaller expenditures on our waterways, but believes that saner methods of spending money on them are required. Instead of making yearly haphazard appropriations, each project in itself should be approved or condemned, and, if approved, authority should be given to carry out the work, a lump sum—based on the estimate of competent engineers—being set aside for the purpose, instead of as it is now done, on the installment plan, with frequent intervals of idleness on account of some filibuster or change in politics.

We are still employing as engineers for our waterways the army engineers of the Government, trained as army engineers and not as water or transportation engineers. They have given ample proof of their efficiency, but this is rather a tribute to their brains than to their training. Long ago there should have been in the United States a separate department (with a cabinet minister at its head) for waterways. It is a decided error in judgment to have the army engineers pass upon the commercial value of a project presented for their consideration, as their training and experience do not make them proper judges of the commercial value of such projects. How frequently have they stated that certain needed links between waterways were of no commercial value because there was at that date no actual freight moving over that route!

Since 1875 $680,552,501, or about $17,000,000 per year have been spent on rivers and harbors in the United States. This is only 4 per cent of the total amount spent on railroads, and is less than has been spent on the waterways of Holland. The United States has not spent enough by far for waterways, and much more will have to be expended.

The general assertion that our railroads move freight at greatly less charges than those of Europe is incorrect. The low-class commodity and bulk freight in Germany, France, Belgium and Holland moves by water. If all such low commodities as moved by water in these countries, with their low rates, were eliminated from the figures for the United States, the general average cost of transportation would be considerably higher. To get a fair comparison there should be omitted from the American figures all those pertaining to the movement of coal, ore, lumber, grain, oil and steel.

CONCLUSION

The great trouble with water transportation in the United States is its absence. There are very few people in the country familiar with the problems of water transportation, and its almost total absence makes the number of its competent champions small. In lieu of these, it has an army of politicians who fight for "water improvement" for the sake of the spoils; a large number of well meaning, poorly led and frequently ill-advised citizens, and a considerable legion of highly trained and experienced transporters who can regard water transportation only from their standpoint in life—that of railroad men.

Inland water transportation is sadly needed, and the writer believes that it can be revived through the following measures:

1. Waterways, harbors, bridges and quarantines should be combined in a new department with a cabinet officer as head, the department employing engineers specially educated for this at West Point, but not under direct charge of the army officials while engaged in the waterway department.

2. The decision as to which of the new waterways, if any, are a commercial necessity, should not be made by such engineers, but by a group of transportation experts, specially employed by the Government.

3. A definite, concise, uniform plan—a system of waterways improvement and development—should be prepared by this department for the entire United States, Congress to modify or improve this and appropriate a yearly lump sum to be spent in approaching this ideal.

4. All States and communities should be in duty bound to build inland water terminals, just as they now feel obligated to build sea terminals.

5. An educational campaign, in municipalities, for the building of belt railroads, warehouses and other facilities of communication to the harbor, should be instituted.

6. The riverfront should be under public ownership.

7. It is an absolute necessity that the abuse of the rail rates to meet water competition shall be stopped; successful water transportation means rail rates tied down to fixed charges per ton-mile, plus terminal charges, and enforced exchange of freight between water and rail terminals.

8. This measure is opposed to the licensing of pilots, or to the compulsory employment of licensed officers.

9. It provides for uniform and federal quarantine law.

10. Our waters and coasts should be open for navigation to any nationality or trade.

Oil-Mixed Concrete Found Generally Damp-Proof

Recent Tests Under Service Conditions Reported by Logan Waller Page Show Good Results for Waterproofing Purposes

THAT oil-mixed Portland-cement concrete is a cheap and effective solution of the problem of producing damp-proof or waterproof structures under low heads is confirmed, in general, by the results of actual service conditions reported by Logan Waller Page, director, Office of Public Roads, in Bulletin 230 just issued as a revision of the previous Bulletin 46 of the U. S. Department of Agriculture. Previous experiments and results were abstracted in the Engineering Record of Oct. 14, 1911, page 445. The following abstract gives the results reported for some actual structures built according to the specifications and directions issued as a result of applications to the Office of Public Roads.

RESULTS OF SERVICE TESTS

The use of oil-mixed concrete on five different sections of road surfaces laid in 1910 in widely separated cities and towns seem to show, to date, that no apparent advantage has been gained by the addition of 10 per cent of oil. Several tanks constructed of oil-mixed concrete in the testing laboratory of the Office of Public Roads have remained absolutely watertight since their completion more than a year ago. One of these tanks was made of 1:2:4 mixture, using 10 per cent of oil, based on the weight of cement in the mixture. It is 4½ ft. deep and is used for storing concrete test specimens, the bottom being 4 in. thick and being deposited on the cement floor of the laboratory. The sides are 6 in. thick and are reinforced with ½-in. deformed steel bars. A second tank was built merely by plastering oil-mixed Portland cement mortar against expanded metal of ½-in. mesh. Although the sides and bottom of this tank are only 1 in. thick, it is absolutely watertight against about 2 ft. head of water.

A number of firms, corporations and individuals applied to the Office of Public Roads for information in regard to using this oil-cement concrete in various structures. Specifications and directions for mixing and using the materials were supplied. Later, inquiries were made relative to the success met with. Many inquiries were not answered, but of the twenty-nine replies received, only three were wholly unfavorable, while a fourth was partly so. The following favorable and satisfactory results are worthy of note:

1. Retaining wall, 1:3:5 concrete with 10 per cent oil; satisfactory in every way.

2. Swimming pool with 20-in. wall under 5-ft. head, original results with "ceresit" unsatisfactory, covered with scratch coat ½ in. thick on which flat tile were laid. It is now two years old and has never leaked since.

3. Eighteen-inch cellar walls 5 ft. high of 1:2:4 concrete with 10 per cent of oil, waterproofed against supersaturated earth filling with excellent results.

4. Mortar mixed 1:2 with 5 per cent oil used to plaster inside of various water tanks of different sizes. Mortar "works" better than plain mortar. Results satisfactory.

5. Eight-inch foundations and a cistern 12 ft. deep made of 1:3:4 wet concrete with 5 per cent oil are perfectly damp-proof.

6. Floor of grain bins covered with 1:1 mortar with 15 per cent oil is perfectly hard and waterproof.

7. Paving block 12 x 14 in. 5 ft. with 1:3 mortar and 2 per cent oil used as facing. Gave hard smooth surface, impervious to moisture.

8. Facing of soffit of concrete arch, 1:2 mortar with 10 per cent oil. Waterproofed concrete is in excellent condition, nonwaterproofed concrete badly disintegrated.

9. Basement walls of buildings subject to ground water action; 1:1:3 concrete with 2 per cent oil is absolutely waterproof, while stone wall above continually admits water.

10. Cellar walls subjected to 4-ft. head of water. Wall 6 in. thick, of 1:2:4 concrete and 10 per cent oil, showed only a slight sweating through the joints.

The following results were unfavorable:

1. Cement blocks for track paving of 1:2:4 wet concrete with 10 per cent oil were not successful; blocks were never used. Oil was added for toughness.

2. Tank to hold 1 per cent solution of sulphuric acid at 150 deg. Fahr. Not successful, acid dissolved concrete.

3. Floor of cellar coated with 1:3 mortar 2 in. thick with 6 per cent of oil. As much water as before coating was applied.

These experiments, on the whole, give very encouraging results and point to the use of oil-mixed mortars and concrete as a cheap and effective solution of the problem of waterproofing for a great many types of concrete construction under low pressure.

Algae Growths Cover Atlanta Sewage Filters

From 2.5 Acres of Beds Laborers Removed About One Ton of Leathery Material

By CHARLES C. HOMMON

Chemist and Bacteriologist in Charge, Atlanta, Ga.

DURING the first part of October, 1914, there began to appear on the upper surface of the stones in the sprinkling filter beds at the Peachtree Creek sewage treatment works in Atlanta (Engineering Record, July 3, page 4) a growth that was later classified as blue-green algae belonging to the Oscillatoria family. The growth was first noticed forming around the risers and nozzles, but soon spread in a fine green film over the whole surface of the filter bed. It appeared that the nozzles formed a sort of nucleus, or starting point for the growth, which gradually became thicker and thicker over the whole bed until in March of this year it was ½ in. thick in places. The heaviest growth extended approximately 3 ft. from each nozzle.

LEFT—TWO TONS OF DRY ALGAE FROM TWO AND A HALF ACRES OF BEDS

RIGHT — LABORERS PICKING UP THE DRY COATING ON FILTERS

The top surface of the growth was dark green in color, while the middle and underneath portions were dark brown. It was leathery in texture and quite firm. When the growth was in a healthy condition it clung very tenaciously to the stones, and sometimes when picking up a piece of it six or eight stones would be so firmly bound together by it that they could be carried from the bed without dropping off. In places it caused considerable pooling of the sewage, but at no time was this serious.

GROWTH DRIES IN APRIL

In the middle of April, however, the growth began to dry up in places, break loose from the stones, and apparently was going to sluff off and pass through the beds. Some of the pieces were 6 in. square, and fearing they might clog up the lower layers of the filter medium or the underdrains, an attempt was made to remove the growth by raking it off. This was not found practical, so laborers were set to work picking it off by hand. It was found that by letting the growth dry from four to five hours it practically freed itself from the filter medium, and pieces as large as 3 ft. square could be picked up.

The filter effluent contained considerably more suspended matter for a few days after the beds were cleaned, but they soon went back to normal and the stones in the beds at the present time are practically as clean as they were before the beds were put into service two years ago. Except for the first few days after the beds were put back into operation there was no apparent difference in the quality of the effluent after the growth was removed. The excellent condition of the filter beds during the spring and summer months suggests the possibility that the matted growth over the surface during the winter held the suspended matter back and thus prevented the usual clogging that takes place in filters during the colder months. The underneath portion of the growth of algae appeared to contain material filtered out of the sewage, and there is no doubt that a great deal of suspended solid matter was held back and much of it oxidized by the algae, which are known to consume a considerable quantity of nitrogen. This class of algae does not give off oxygen to the same extent that some of the other algae do, but the oxygen they did give off and the suspended solids held back and partly oxidized must have been beneficial to the filters during winter.

EFFECT OF COLD WEATHER

The writer believes that these growths ought not to be disturbed during cold weather, or as long as they remain in a healthy growing condition and cling tightly to the surface of the stone, but when they threaten to break up and pass on through the filters it is time to put the filters out of service, allow the growth to dry out, and remove it.

Ten laborers cleaned 2.5 acres of filter beds in four days and removed approximately 2000 lb. of material. Allowing $1.50 per day per laborer and $3 per day for a foreman, made a total cost of $72 for cleaning 2.5 acres of filter beds, or $28.80 per acre.

Cost of Bituminous Surfacing for Roads Analyzed

California Highway Department Itemizes Figure of 8.46 Cents Per Square Yard Paid for Typical Surfacing on Concrete Base

BITUMINOUS surfacing has recently been completed on an 8-mile stretch of highway near San Luis Obispo, Cal., in Division V of the California highway system. Carefully itemized costs have been kept by the division engineer on each part of the work, and they have been summarized in the following cost data. The figures are based on two coats of oil, each applied at the rate of ¼ gal. per square yard. The concrete base was 15 ft. in width and the stretch to be surfaced 43,660 ft. in length, making a total area of 72,766 sq. yd.

In Table 1 the cost of oil is based on the price paid by the State when buying oil in 5000-bbl. quantities and includes delivery to the siding nearest the work, unloading from the cars and heating ready for use. The price of broken-stone screenings includes delivery in piles along the pavement as desired by the contractor. The total cost in the table divided by the area gives a unit cost of 7.69 cents per square yard, to which it was considered fair to add 10 per cent for division superintendence and headquarters overhead, thus bringing the total unit cost up to 8.46 cents per square yard.

APPLYING ROAD OIL ON A CONCRETE BASE IN CALIFORNIA

TABLE 1—MATERIAL AND LABOR COST

Materials:	
Oil, 1191.6 bbl. at $1	$1,191.60
Screenings, 1036.85 tons at $1.16	1,202.74
Screenings, 690.14 tons at $1.12	772.96
Incidental tools and supplies	217.99
Interest and depreciation on oil plant and equipment	96.00
Labor:	
Total payrolls and truck rental	2,113.01
	$5.594.30

An analysis of the cost of handling the oil shows that on this particular stretch of highway 1191.6 bbl. were unloaded and heated at a total cost of $405.31, or 34 cents per bbl. This sum was made up as shown in Table 2.

TABLE 2—COST OF OPERATING OIL HEATING PLANT

Total materials	$88.46
Total labor	184.00
Interest and depreciation	96.00
Overhead and supervision (10 per cent)	36.85
	$405.31

The oil was hauled in a 5-ton motor truck an average of 8.5 miles from the railroad siding, one truck supplying an average of 2000 lin. ft. of 15-ft. pavement per day. The truck and operators cost $20 per day and the cost of applying the oil was therefore 0.6 cent per square yard. The concrete was cleaned by a horse-drawn broom assisted by laborers with hand brooms. The crew of three laborers and a double team, the latter being required only half time in order to keep up with the laborers, could average about 4020 lin. ft. of 15-ft. pavement per 8-hr. day at a total cost of $9 per day, or 0.134 cents per square yard of surface. The laborers were paid at the rate of $2.25 per day and the team at $4.25 per day.

Screenings were unloaded by hand, being shoveled from cars into patent loading chutes in a 5-ton motor truck, and were then hauled to the desired points along the road. The average daily cost of unloading was therefore 16 cents per ton. The trucks made trips averaging 1.6 miles in length over excellent roads, and handled 1727 tons at a cost of $944.69 or 12.2 cents per ton-mile. This, however, does not include interest or depreciation charges.

After the oil had been applied, a suitable amount of crushed rock screenings were spread so as to absorb all surplus oil and take up the "bleeding." The work of spreading the screenings cost 0.405 cents per square yard, this item including five laborers at $2.25 per day, accompanied for a time by a double team and driver at $4.50 per day. On the total area of 72,776 sq. yd. there were used 50,047.2 gal. of oil, or 0.689 gal. per square yard, and 17,227 tons of screenings, or 0.0238 tons per square yard.

The work was done under the general supervision of Austin B. Fletcher, State highway engineer. W. C. Howe was division engineer in immediate charge of the work.

EIGHT TUNNELS, seven of them double-tube, and five bridges, costing collectively probably $150,000,000, will connect Long Island with the west bank of the East River when the facilities now being built or proposed for immediate construction in New York City are finished. The bridges, from the upper bay to the sound, are the Brooklyn, Manhattan, Williamsburg, Queensboro and Hell Gate bridges. The tunnels, counting the same way, are the present subway tubes, the Whitehall-Montague Street tunnels, the Old Slip-Clark Street tunnels, the Fourteenth Street-Eastern tunnels, the Pennsylvania tunnels, the Queensboro or Steinway tunnels, the Sixtieth Street tunnels, and the Consolidated Gas Company's Astoria tunnel.

Cincinnati Plant Has Eliminated Water-Borne Typhoid

Annual Report of Water Department Shows High Efficiencies of Settling Basin and Low Operating Costs

TYPHOID statistics of Cincinnati for 1914 show an enormous reduction in the number of cases—fewer cases, according to the latest annual report of the water department, than were ever reported before since the municipality became a real city. For the four years, beginning with 1904, previous to the construction of the filter plant, the number of cases was 1646, 746, 1940 and 1252. The deaths for these years were 279, 155, 239 and 157. For the seven years since the plant has been in operation cases each year are reported as follows, the last year being 1914: 235, 218, 183, 238, 187, 266 and 128. For corresponding years the number of deaths was 67, 46, 21, 43, 28, 23 and 23. The population is about 406,000.

PLANT EFFICIENCIES

The efficiency of the settling basin in removing turbidity has been 9 per cent greater than ever before, 74.1 per cent of the sediment-producing turbidity being settled out. The average turbidity was 120 parts per million, as compared with 204, the average of the preceding six years. The median turbidity was one-half of the average.

Entering the coagulating basin the water contains an average of 31 parts per million, 62 per cent less than in the preceding six years. These basins removed 21.7 per cent, the lowest record since the plant was started. The water went to the filter with one-fourth the usual amount of turbidity, 5 parts only.

Sulphate of iron was applied at the average rate of 170 lb. per million and the lime at 95 lb.

Wash-water to the extent of 2.24 per cent was used, as compared with 2.65 per cent in 1913. The average period of service of the filters was 19.5 hr., or 2.24 hr. longer than for the preceding year. This was due principally to less trouble with microscopic plant growths in the river and settling basin.

Bacterially the filtered water contained an average of 36 germs per cubic centimeter and the median number was 20. In the river there were 16,500 bacteria per cubic centimeter on the average, but the median number was only 2900. For 54.54 per cent of the time the numbers ranged from 1000 to 100,000 bacteria per cubic centimeter. Liquid chlorine, equal to 0.82 lb. per million gallons, was applied to the filtered water, reducing the numbers of bacteria 83.6 per cent. During 95 per cent of the time the filtered water had less than 100 bacteria. The B. coli index indicates that approximately 15,000 bacilli of this species were present in every liter of river water, while only two or three could be found in the same amount of filtered water.

COST OF OPERATION

The total cost of operating and maintaining the plant was $3.38 per 1,000,000 gal. of filtered water delivered into the service mains. Of this amount $0.39 was for maintenance and $1.21 for coagulating chemicals. The chlorine cost was 8.6 cents per million gallons. Total costs per million gallons for the six years previous to 1914 were $4.24, $4.26, $4.19, $4.12, $3.84 and $3.92, and for chemicals, $1.72, $1.89, $1.93, $1.86, $1.78 and $1.67.

NEWS OF THE WEEK

Passing Even[illegible] in the Civil Engineering and Contracting Fields

Arkansas City Fights Losing Battle to Save Its Levee

Five thousand sand bags used in reinforcing the city levee at Newport, Ark., proved of no avail in saving the levee when the Mississippi reached an unprecedented stage during the heavy storms and rains of the last two weeks in August. In regard to the exact extent and nature of the damage to the levee at Newport, A. S. Madding, city engineer, in a letter to the Engineering Record, says:

"Owing to the fact that the water is still very high, it would be impossible to give anything but a rough estimate of the damage done, but the new causeway across Newport Lake, connecting Newport and East Newport, seems to be damaged more than any of the levees in this immediate vicinity. This causeway was completed last spring at a cost of approximately $30,000. Its surface was temporarily made of shells, as the engineer, Major W. J. Parks of Pine Bluff, was contemplating paving it this winter. Owing to the depressed financial conditions in this county at present, due to the damage done by the overflow, it is probable that the causeway will be rebuilt at once, but will not be paved this winter. The present estimated damage to the causeway is placed at $5,000.

"Newport is built in a triangular shaped area and is surrounded by levees built by the Iron Mountain Railroad, the Rock Island Railroad and the city. The city levee despite its sand-bag reinforcing broke early in the flood. Most of the water, however, came in through the Rock Island dump from Newport Lake. When the water started receding the city levee was dynamited in several places in order to let the water go out that way. The Iron Mountain Railroad Company's engineers estimate their damage at $100,000, the greater portion of which is in this county.

"The Village Creek levee, which is about 9 miles below this city on White River, is reported to have broken in six places, but the engineers have made no estimate of the damage.

"The sanitary work is being conducted under the direction of Dr. J. H. White, senior surgeon of the United States Public Health Service, and Dr. C. W. Garrison, State health officer, who were joined Sept. 3 by J. A. La Prince, chief sanitary engineer for the United States Government. Large forces of men are working under these officials, and every effort is being made to restore things to normal conditions. It is reported that work will be begun on all levees immediately."

Texas Law Will Compel Building of Many Sewage-Disposal Plants

Many sewage-disposal plants will be built in Texas within the next year or so due to the going into effect, Jan. 1, 1917, of the new anti-stream-pollution law, which prohibits the emptying of raw sewage into the streams of the State.

Los Angeles Garbage Controversy

The Board of Public Works of Los Angeles has arranged temporarily to sell to ranchers and stock raisers in the vicinity the city's accumulation of garbage—about 274 tons a day—pending settlement of a controversy between the city and the Pacific Reduction Company over the question of water rental. The reduction company contends that the city should furnish free of cost all the water necessary for the operation of the reduction plant. The city admits its obligation to supply water but claims it is entitled to charge for the service. A necessary contemplated increase in the capacity of the reduction plant is being delayed by the company until the water question has been adjusted. The city plans, in the meantime, subject to the approval of the Los Angeles City Council, to apply the revenue from the sale of the refuse toward the purchase of automobile trucks for hauling garbage from Hollywood to the reduction plant in Los Angeles. If the water question is settled shortly, however, the reduction company expects to be able to handle the entire garbage accumulation of the city by the first of the year.

Survey Looking to Improvement of Colorado River Recommended

The Chamber of Commerce of Austin, Tex., has received information to the effect that Lieut.-Col. Charles S. Riche, Corps of Engineers, U. S. A., in charge of the Galveston District of the Gulf Division, has recommended that a survey looking to the improvement of the Colorado River be made. It is estimated that the cost of making this river navigable would amount to $8,000,000.

Colorado Branch of American Society to Entertain Visiting Engineers

Sightseeing trips from Colorado Springs to the Garden of the Gods by four different routes have been arranged by the Colorado association of members of the American Society of Civil Engineers, for the benefit of members of the various National engineering societies en route to the International Engineering Congress at San Francisco. The association will not hold any formal meeting in September.

Pennsylvania Has Made No Move to Enter Detroit

Newspaper reports that the Pennsylvania Company, which operates the Pennsylvania Lines West of Pittsburgh, would spend $20,000,000 to effect an entrance into Detroit, are entirely without foundation, writes a representative of that company. Vice-President Atterbury, who, it was alleged, had given out the information, was not in Detroit the day he was said to have made the statement there.

Milwaukee May Spend $2,000,000 a Year on Sewerage System

At the last minute the State Legislature of Wisconsin passed a bill enabling Milwaukee to issue bonds to the extent of $2,000,000 per year for a sewerage system and disposal works. The City Council must exercise its judgment as to how much shall be issued each year. An ordinance for a part of the $2,000,000 for this year's needs is now before the Aldermen.

The 2,000,000-gal. activated-sludge plant, which was started in July, is well under way, bids for the machinery being received Aug. 19. This is the first activated-sludge plant built for service in this country. It will have a 4-hr. period of aeration, a 25-per cent sludge content and 25-min. sedimentation. The plant is to be completed by Nov. 15 so that it may be operated throughout the winter to determine the effect of low temperatures on the continuous-flow method. No time will be lost in starting. Activated sludge with which to seed the new plant is being manufactured at the testing station. The sewerage work in Milwaukee is being carried out under the direction of T. Chalkley Hatton, chief engineer of the sewerage commission.

New England Men Plan Memorial for Dexter Brackett

Committee Named to Raise Fund at Thirty-fourth Annual Convention of Waterworks Association in New York This Week

Members of the New England Waterworks Association at the thirty-fourth annual convention held at the Waldorf-Astoria Hotel, New York, Sept. 7, 8 and 9, have completed plans for perpetuating the memory of Dexter Brackett, past-president of the association, who died August 26. By a resolution proposed by Charles W. Sherman of Boston a fund is to be raised and its interest devoted to a prize for the best paper each year or to research work, the final arrangement being left to the executive committee of the association. President Leonard Metcalf appointed Frederic P. Stearns, Alfred D. Flinn and Allen Hazen as a committee on the Brackett memorial.

The convention opened on the morning of Sept. 7 with an active membership of 965, the largest in the history of the association. On the morning of Sept. 9 the secretary's records showed a registration of 586, of which 213 were members, 261 guests and 112 associate members.

President Metcalf's Message

In acknowledging the good wishes for the convention's success, expressed by New York City officials on Sept. 7, President Leonard Metcalf said in part:

"There is manifest throughout the country a tendency toward progressive development based upon a policy of placing in charge of large works men whose abilities have steadily been proved in smaller tasks. This policy of promotion on merit augurs well for the future of the waterworks profession. Another factor which will surely contribute to larger things is the spirit of co-operation which exists among waterworks men in the United States. It is unparalleled the world over, and I say this after having observed conditions in the principal European countries. It is attributable in large measure to the work of such associations as ours. The Catskill aqueduct, now nearing completion, is a convincing demonstration that municipal waterworks on a large scale can be constructed efficiently, economically and honestly if responsibility is placed upon engineers of tested ability."

Status of Catskill Aqueduct

At the first session J. Waldo Smith, chief engineer of the New York Board of Water Supply, told of the present status of the Catskill aqueduct work. The aqueduct proper, 92 miles long, will be completed next month and more than half of it has been carefully tested. Recent hydraulic experiments have disclosed that its capacity, making a reasonable allowance for loss due to growths which accumulate in years of use, is about 650,000,000 gal. per day. Tests at two of the deep pressure tunnels have disclosed a surprisingly small amount of leakage. The Ashokan reservoir is substantially completed and at the present time contains about 80,000,000,000 gal. of a total of 128,000,000,000 gal. of water.

Studies for a filtration plant in connection with the Catskill supply are under way, but, if built, it cannot be completed before 1920.

It is confidently expected, Mr. Smith stated, that by Jan. 1, 1916, the aqueduct will be in a condition of a large machine with many working parts which have just been assembled for the first time and which have not been adjusted or tested. Some of the parts of the machine are necessarily of new and untried design to satisfy conditions never before met with. The problem that will then confront the Water

Board on Jan. 1, 1916, is the adjustment and test of this machine, the training of the operating force and the "tuning-up" and synchronizing of the entire plant. It is believed that this may require all of the year 1916.

Water Supply Across Swamp

How the cities of Beverly and Salem, Mass., have united forces in a plan to deliver an auxiliary water supply from the Ipswich River through a canal crossing two miles of swamp land to an existing reservoir was explained by Francis F. Longley of the firm of Hazen, Whipple & Fuller. Although the design of the work was comparatively simple there were complicating factors relating to the time at which water might be taken from the river, its quantity and the minimum flow of the stream. The scheme of delivery by the open canal proved to be far more economical than the pipe line and after the swamp had been cleared during winter a dredge cut a new channel.

In his paper delivered Tuesday evening H. W. Clark of the Massachusetts State Department of Health told how the water supply of South Norwalk, Conn., was improved both physically and bacteriologically by double sand filtration. At this plant the algae problem was solved without resort to the use of copper sulphate.

In the discussion Allen Hazen characterized the South Norwalk work as the most complete for removing tastes and odors ever built. "We have devoted a great deal of attention to the removal of disease-producing bacteria from water supplies," Mr. Hazen said, "but have given scant attention to the betterment of water's physical properties. There is an opportunity for much useful work along this line."

In response to President Metcalf's request for a few words from the president of the American Waterworks Association, Nicholas S. Hill, Jr., of New York City, made an urgent plea for the amalgamation of all waterworks interests in the United States in a single National body. This question, it will be recalled, arose at the Cincinnati convention of the American association last year and George G. Earl, then president of the American association, made the suggested merger the chief topic of his presidential address.

New Committee on Leakage

A new committee on leakage and pipe joints was appointed at this week's convention. It is the outgrowth of the discussion which followed the paper on "A Test of Leakage from Lead Joints," by Arthur H. Smith, engineer, Associated Factory Mutual Fire Insurance Companies of Boston. The committee consists of Frank A. Barbour, Carleton E. Davis, S. E. Killam, Caleb M. Saville, Henry B. Machen and A. H. Smith.

Three of the association's past-presidents were elected to honorary membership this week. They are Edwin C. Brooks, formerly superintendent of the Cambridge water department; George A. Stacy, superintendent of the Marlboro (Mass.) waterworks, and Robert J. Thomas, superintendent of waterworks at Lowell, Mass.

The nominating committee to select officers to be ballotted on next year was named by President Metcalf as follows: F. A. McInnes, of Boston; E. W. Kent, of Newport, R. I.; J. Waldo Smith, of New York; E. E. Lochridge, of Springfield, and A. E. Blackmer, of Boston.

Discuss Valves

At the superintendent's session Wednesday morning, interest centered upon the subject of valves, but no agreement was reached as to the relative merits of valves of the solid wedge or the double disk type. The topic was introduced by papers read by George H. Finneran, of Boston, and J. M. Diven, of Troy, N. Y. In the Boston Water Department, which manufactures all of its own valves, a decided preference for the solid wedge type is manifest. This opinion was also concurred in by A. O. Doane, of the Metropolitan Waterworks, Boston. Many of the other speakers, however, favored the double-disk valve.

A valuable paper for anyone who is contemplating the construction of wire fences with concrete posts was the one by Ralph N. Wheeler, department engineer, Board of Water Supply, New York City.

Excursions

On Wednesday the convention went by boat down New York Harbor and up the Hudson River, while for Thursday, the last day, a trip to the Kensico dam of the Catskill aqueduct was scheduled.

Program for Pan-American Road Congress Issued

The official program of the Pan-American Road Congress, to be held at Oakland, Sept. 13-17, has been issued. The official hotel headquarters will be at the Hotel Oakland. The congress will be opened at 10.30 a. m., Sept. 13, with addresses by governors from four States. There will also be addresses by the Mayor of Oakland; James A. Barr, director of congresses at the exposition; Fairfax Harrison, president of the American Highway Association, and G. W. Tillson, president of the American Road Builders' Association, and consulting engineer to the borough president of Brooklyn.

There will be morning and afternoon sessions throughout the congress. Papers will deal with the history and future of highway improvements, highway legislation, National, State and local responsibility for road conditions, location, drainage, foundations, bridges and structures, limitation and regulation of highway indebtedness, surfacings and resurfacings, accounting, engineering supervision, justifiable outlay, convict labor, equipment, traffic, maintenance, dust suppression and cleaning.

Among the speakers there will be G. W. Tillson; A. N. Johnson, highway engineer, Bureau of Municipal Research, New York City; Col. E. A. Stevens, State commissioner of public roads, New Jersey; William R. Roy, State highway commissioner, Washington; Paul D. Sargent, chief engineer, State Highway Commission, Maine; George W. Cooley, State engineer, Minnesota; W. S. Gearhart, State engineer, Kansas; Clifford Older, bridge engineer, State Highway Department, Illinois; Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City; A. B. Fletcher, State highway engineer, California; H. R. Carter, highway engineer, Arkansas; Prof. L. S. Smith, department of highway engineering, University of Wisconsin; A. D. Williams, chief road engineer, West Virginia; W. A. McLean, chief engineer, Ontario Highway Commission; F. F. Rogers, State highway commissioner, Michigan; W. D. Uhler, chief engineer, State Highway Department, Pennsylvania; J. C. Little, chief engineer, Roland Park Company, Baltimore; Curtis Hill, city engineer, Kansas City; M. M. O'Shaughnessy, city engineer, San Francisco; A. R. Hirst, State highway engineer, Wisconsin; H. E. Breed, first deputy State highway engineer, New York; W. W. Marr, chief highway engineer, Illinois; T. H. MacDonald, State highway commissioner, Iowa; Lamar Cobb, State engineer, Arizona; Prevost Hubbard, chief, U. S. Division of Road Material Tests; Henry Welles Durham, consulting engineer, New York City; G. P. Coleman, State highway commissioner, Virginia, and J. E. Maloney, engineer, State Highway Commission, Colorado.

Artist's Conception of Rock Excavation Wins Prize

The accompanying illustration is reproduced from an artist's conception of "Labor." The painting was a prize picture resulting from a movement described in the *Literary Digest.* The European war has driven to this country many young artists, who, without connections or plans, have been unable to turn their art into a means of livelihood. To encourage them to continue their efforts rather than enter other fields, a movement was launched for establishing competitions with cash prizes. The subject of the painting competition conducted early this summer was "Labor," and many of the paintings had to do with civil engineering endeavor, such as the construction of skyscrapers, and the digging of the Panama Canal. The picture shown was by Martinus Anderson, and was considered particularly American.

Courtesy, Literary Digest

ROCK EXCAVATION UNDER THE ARTIST'S BRUSH

General Goethals Urges Revision of Panama Toll Rules

Maj. Gen. George W. Goethals, speaking before the San Francisco Commercial Club Sept. 8, expressed the need for uniform rules for measuring vessels and charging tolls at Panama Canal. The present system lacks such rules, and he thinks the basis of charges should be carrying capacity, including deck loads.

Russia Places Large Rail Order in United States

The Russian Imperial Railways Commission has placed orders for 115,000 tons of rails and accessories, which will be furnished by the Cambria Steel Company, the Pennsylvania Steel Company, the Illinois Steel Company and the Tennessee Coal, Iron & Railroad Company. Robert W. Hunt & Company have been commissioned to make what is known as their "special inspection" of these 115,000 tons of rails and accessories.

Northwestern Highway Men to Meet in Cedar Rapids

Plans for the second annual meeting of the Northwestern Road Congress, to be held at Cedar Rapids, Iowa, Oct. 4 to 7, have been completed and the advance program issued. Twenty-one papers dealing with various phases of road work are scheduled for presentation. Among the papers to be read are those by W. W. Marr, Illinois State highway engineer, on "The Value of a Traffic Census in Determining the Type of Road to Be Constructed," and Dean A. Marston, Iowa State highway commissioner, on "The Highway Engineer—His Present and Future Field."

News of Engineering Societies

The Northwestern Association of Members of the American Society of Civil Engineers will hold its annual meeting at the St. Paul Commercial Club, St. Paul, Sept. 17. Dinner will be served and officers for the coming year will be elected. The subject of discussion will be "Foundations for Buildings and Engineering Structures." The discussion will be led by W. E. King, C. R. Sheply, W. L. Darling, C. F. Spaldy, A. S. Cutler and F. W. Cappelen.

Personal Notes

GLENN A. GRAY, district engineer of the water resource branch of the U. S. Geological Survey, will have charge of the office which will be established at Austin, Texas, for the purpose of working in conjunction with the State Board of Water Engineers on stream measurements in that State.

JOHN H. LEWIS, State engineer of Oregon, was relieved of all duties and responsibilities in connection with highway work done by the State Highway Commission, Aug. 27, by vote of the commission. This action was taken at the request of Mr. Lewis and puts an end to the controversy as to whether Mr. Lewis or E. I. Cantine, chief deputy State engineer, was the actual highway engineer.

DR. J. A. L. WADDELL, consulting engineer of Kansas City, has entered into partnership with his son, N. Everett Waddell, to continue practice as consulting engineer under the firm name of Waddell & Son, Graphic Arts Building, Kansas City. The firm of Waddell & Harrington, with which Dr. Waddell was previously connected, was dissolved, except insofar as relates to certain unfinished work, July 14. N. Everett Waddell was graduated from Rensselaer Polytechnic Institute in 1908 and was connected with Waddell & Harrington, on bridge work until 1909, when he was appointed draftsman for the McClintic-Marshall Construction Company. He left this firm for a few months in 1910 to engage in special work for the Grand Trunk Railroad and returned to it as resident engineer on the $2,200,000 Missouri River bridge at Kansas City. In 1911 he rejoined the forces of Waddell & Harrington, in which service he remained until the firm was dissolved, his latest assignment being that of assistant to the resident engineer on the construction of the Twelfth Street Trafficway, Kansas City, Mo.

B. H. TONG, formerly assistant to C. H. Young, city engineer of Muscatine, Iowa, is now engineer for Elmer L. Gochanour, general contractor of Grandview, Iowa. He is engaged, at present, on concrete pavement construction at Burlington, Iowa.

F. G. COOK, formerly assistant engineer maintenance-of-way of the Northern Pacific Railway at Jamestown, N. D., has been appointed roadmaster at Mandan, N. D.

F. L. BIRDSALL has resigned from the office of superintendent of the Rocky Mountain division of the Northern Pacific Railway.

T. F. LOWRY, formerly superintendent of the Minnesota division of the Northern Pacific Railway, has been appointed superintendent of the Rocky Mountain division, succeeding F. L. Birdsall, whose resignation is noted elsewhere in these columns.

J. R. HOLMAN, chief engineer of the Oregon-Washington Railroad & Navigation Company, will go on an indefinite leave of absence about Sept. 15, in an effort to recover his health, which has been failing for some months past.

KENNETH A. HERON, for some time in charge of the irrigation investigations for the Modesto Irrigation District, has been appointed chief engineer for the Goose Lake Valley Irrigation Company of Lakeview, Ore., which recently took over the irrigation system of the Oregon Valley Land Company. Mr. Heron received his professional education at Cornell University and George Washington University. His first service was as assistant engineer for the water department of the Colorado Fuel & Iron Company at Pueblo, Col., from 1906 to 1910. From the latter year until 1911 he served as field engineer for the Amity Canal Company of Holly, Col. He left this work to become designer and office engineer for Ford, Bacon & Davis on the Valier project in Montana. He was also with the same firm later on irrigation work in California. He left the company to take up the Modesto work. His new work will consist of extending the Goose Lake Valley Irrigation Company's system to water all the irrigable lands in the Goose Lake Valley in Oregon. The first unit of 15,000 acres will be placed under laterals this fall.

CHARLES M. DILL, formerly estimator and salesman in the main offices of the Witherow Steel Company, manufacturer of reinforcing steel, structural steel and building products, of Pittsburgh, has been appointed sales engineer in charge of the company's newly opened branch office, Builder's Exchange Building, Philadelphia.

VANNOY H. MANNING, assistant director of the U. S. Bureau of Mines, has been appointed director of that department to succeed the late Dr. J. A. Holmes.

J. D. MACK, for many years professor of mechanical engineering at the University of Wisconsin, has been appointed State engineer of Wisconsin by the State Railway Commission, under the law recently passed in that State creating such an office. The appointment requires the Governor's approval before becoming effective. The salary connected with the position is $6,000 per year.

WILLIAM C. PICKERSGILL, assistant engineer of the New York Board of Water Supply, has been retained as designing engineer by the Water Supply Board of Providence, R. I.

D. T. CORNING, formerly assistant to the mining engineer of the Cambria Steel Company, Johnstown, Pa., and manager of its subsidiary concerns, the Cambria Inclined Plane Company and the Manufacturers' Water Company, has been appointed assistant engineer in the Bureau of Highways of the Department of Public Works of the city of Philadelphia.

J. W. REAGAN, minority member of the recently disbanded Board of Flood Control of Los Angeles County, was appointed chief engineer of the Los Angeles County flood control district at a meeting of the board of supervisors, Aug. 30. The salary fixed upon was $3,000 per year.

ROBERT A. ZENTMYER, of Tyrone, Pa., has been appointed a member of the Pennsylvania State Water Supply Commission.

R. D. STARBUCK, formerly special engineer on the staff of J. H. Bernet, resident vice-president of the New York Central Railroad at Chicago, has been appointed special engineer on the staff of A. T. Hardin, vice-president in charge of operation at New York City.

HARVEY C. SHAW, superintendent of waterworks at Warren, Pa., has been transferred by the American Waterworks & Electric Company, to Joplin, Mo., where he will be superintendent of the Joplin Waterworks Company.

Obituary Notes

JAMES O'BRIEN, who was identified with the early hydraulic mining operations of Central California and a pioneer builder of irrigation and power projects in that State, died at Marysville, Cal., Aug. 29, at the age of 83 years.

JAMES F. KEON, of the firm of Ryan & Keon, railway contractors of Boston, died in New York City, Sept. 1.

SIDNEY T. EMERSON, a retired railroad civil engineer, died at his home in Chicago, Aug. 28. Mr. Emerson was born in Saratoga County, New York, in 1827. He came to Chicago in 1869, when he joined the engineering corps of the Illinois Central Railroad. Mr. Emerson served as a consulting engineer for the Government and a number of railroads, including the Pennsylvania, Missouri Pacific and Northern Pacific.

EDWARD F. MCCREA, division engineer of the Pennsylvania Lines West of Pittsburgh, at Cleveland, died in Logansport, Ind., Aug. 29.

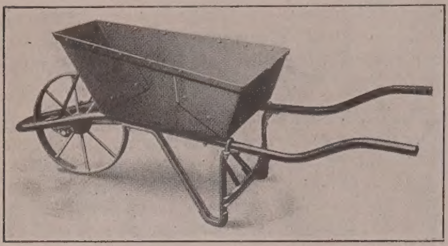
FRANK E. JOHNSON, who was for fifteen years instructor in civil engineering at the University of Washington, died in Seattle, Aug. 25.

EDWARD B. PLEASANTS, chief engineer of the Atlantic Coast Line Railroad, whose death was noted in these columns last week, started in engineering work on the U. S. Coast and Geodetic Survey, in which service he remained five years. He entered railway service as assistant engineer on the Baltimore & Ohio. In 1878 he was appointed assistant engineer on the Baltimore & Lehigh, of which he subsequently became chief engineer. In 1886 and 1887 he was engineer in charge of the construction of the Baltimore, Annapolis & Sparrows Point, from which service he resigned to go to the Norfolk & Carolina, now the Atlantic Coast Line System. He was appointed chief engineer of this system in 1902.

WILLIAM L. ZIEGLER, engineer of construction for the Pennsylvania Railroad, died Aug. 6. He was 48 years in the service of the Pennsylvania, entering it in 1867 as chainman in the office of the division engineer, and continuing in up to the day of his death. He was promoted to the grade of assistant engineer in 1873 and to that of engineer of construction in 1877. Subsequently he was in charge of some of the most important improvements made by the company in the vicinity of Philadelphia, including the Market Street slip and ferry house, pier work and the new West Philadelphia station and tunnels.

Barrow Designed for Measuring Concrete Ingredients

The Sterling Wheelbarrow Company, of West Allis, Wis., has placed a new barrow on the market for the measuring of concrete ingredients. The barrow, which is shown in an accompanying illustration is built in 2 ft. and 3 ft. sizes.



Gasoline Shovel Has Tapered Hoisting Drum

Run by a four cylinder, four cycle gasoline engine, operating at constant speed, and connected through a shaft having a heavy fly-wheel with the operating mechanism, the Marion gasoline shovel is designed with a tapered hoisting drum to give low speed and heavy pull while the dipper is digging and higher speed with a lighter pull when the load is being hoisted. This feature, combined with the fly-wheel, relieves the motor from sudden strain when the dipper begins to dig. The shovel is operated by band frictions controlled by levers banked and operated exactly as in the Marion steam shovel. It is made only in the revolving type, as the chief field for gasoline shovels is on city work, where smoke is objectionable, or where it is desired to replace hand-labor.

The shovel, being driven entirely from the main shaft, can be converted into an electric shovel by simply substituting an electric motor of the proper size for the gasoline engine. The shovel is self-propelling.

The reversing motion necessary for propelling is obtained by means of frictions and a reversing shaft on which the right-hand friction turns in one direction, while the left hand friction turns in the opposite direction. While the primary purpose of the reversing gears is to impart propelling motion to the shovel, power for the hoisting, swinging and crowding motions must be transmitted from the same shaft. It is evident, therefore, that further means must be provided for throwing the propelling motion in and out of gear. This is done by a friction and gear mounted on the end of the hoisting-drum shaft. The gear meshes with a gear keyed to a horizontal shaft running directly over the rotating center. The opposite end of this shaft has a bevel pinion which engages the bevel pinion on the vertical propelling shaft, the lower end of which is designed exactly as on a steam shovel. To operate the swinging mechanism the reversing shaft also carries a spur gear engaging a gear on the swinging or bull-pinion shaft. On each end of this shaft is mounted a driver keyed to the shaft and a friction housing which is keyed to a gear mounted loosely on the shaft and fitted with bronze bushings. This gear is operated by an outside band friction, and engages a gear keyed to a shaft directly below and forward. On the other end of this last shaft is keyed a bevel pinion meshing into the swinging crown gear, which, in turn, is keyed to the vertical swinging shaft. On the other end of this vertical swinging shaft, which is exactly like that on a steam shovel, is keyed a spur pinion, which in turn meshes to the large rotating gear on the lower frame of the shovel. Since the same mechanism is applied at each end of the bull pinion shaft, and since the bevel pinions engage the swinging crown gear at opposite sides, a reversing motion is obtained, as in the case of the propelling mechanism, by throwing in the opposite friction.

Forward of the hoisting drum shaft, and connected to it by means of an intermediate shaft, is another set of reversing frictions. These frictions control the crowding of the dipper handle. These frictions are both controlled by a single lever arranged so that when it is in central position both frictions are released and a brake is set to hold the dipper handle in any position. The shaft leading from the frictions to the boom is provided with a telescopic joint to allow for the variation in the height of the boom. It carries beveled pinions on each end, engaging bevel gears. The rest of the boom is exactly the same as on a steam shovel.

Business Note

William Graver, president of the William Graver Tank Works, East Chicago, Ind., died at his home in Chicago, Aug. 25. Mr. Graver was born at Chambersburg, Pa., in 1842. When 15 years old he entered the tank works of his uncle. In 1884 he came to Chicago and immediately secured a contract for field tanks at Lima, Ohio. The contract was larger than his plant, and in order to be near the point of delivery he moved his plant to Ohio. In 1888 he formed the company which bears his name. From a plant employing 20 men it has increased until to-day it employs from 500 to 750.

Trade Publications

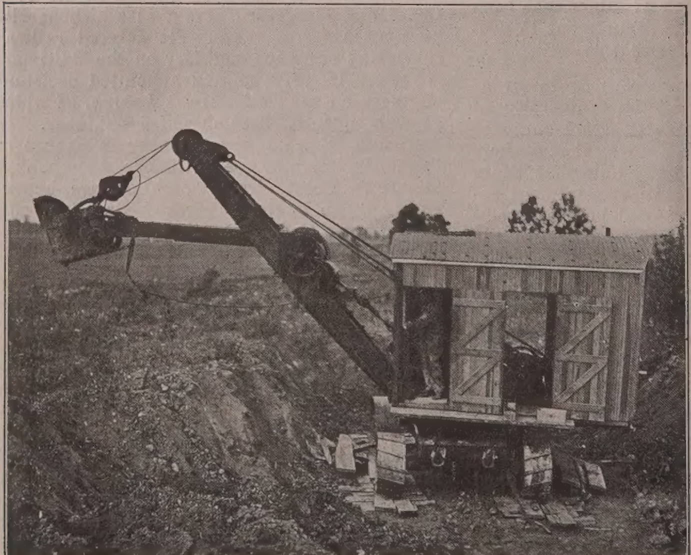
The following companies have recently issued trade literature:

Thomas Method of Reinforced - Concrete Construction, by William M. Thomas, consulting engineer, Los Angeles, Cal. Pamphlet, 9 x 12 in., 20 pages, illustrated. This publication deals with the Thomas method of bridge design for three-hinged reinforced-concrete arch and girder bridges.

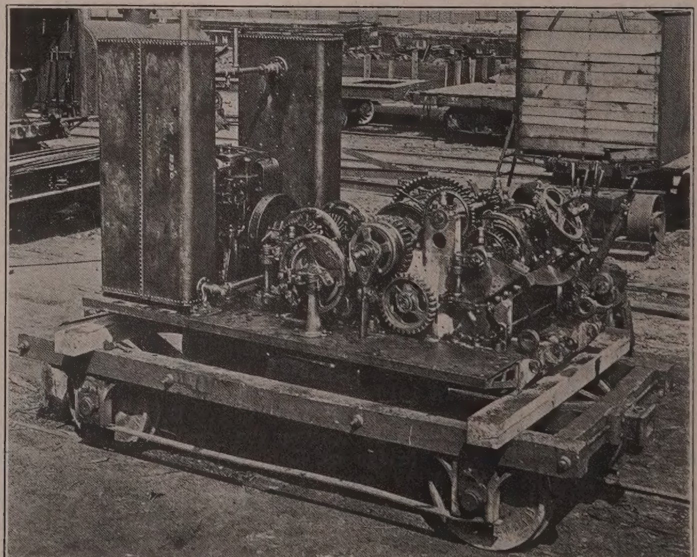
Burd High Compression Ring Company, Rockford, Ill. Catalog, 4½ x 6¾ in., 134 pages, illustrated. A comprehensive directory of piston ring sizes, which are coded, for automobiles, cycle cars, trucks, tractors and engines, giving the date of model, make, class, rings per piston and cylinders, is printed in the first part of this book. A second part describes the Burd high compression ring, its manufacture, its adaptability to resist carbonic destruction and the manner in which it is applied to cylinders. And a third, and last, section contains an alphabetical list of makes of cars, trucks, tractors, etc., for which Burd rings are supplied, with references to the directory in which their sizes are listed, and tables for decimal and millimeter conversion.

Sherwin - Williams Company, Cleveland, Ohio Booklet, 4½ x 6 in., 32 pages, illustrated, entitled, "Protective Paints for Metal Surfaces." This publication explains in a concise and practical manner metal corrosive troubles and essential characteristics of paints that are protective. It relates the history of Sherwin-Williams Company's experimentations on this subject and describes the resulting products; carbon paint, Red Diamond brand and Metalastic brands, red leads, iron primer and stack and acid resisting paints. The illustrations reproduce photographs of structural steel painting on high buildings and bridges. Instructions on applying protective paint are also included in the booklet.

Bausch & Lomb Optical Company, Rochester, N. Y. Catalog, 6½ x 9¾ in., 36 pages, illustrated. Describes chemical, metallurgical, measuring and comparative miscroscopes, photomicrographic and metallographic apparatus for the microscopical inspection of structural metals, concretes and paints, and appurtenances elaborating these equipments. The Johnson photomicrographic outfit for concrete, designed with the assistance of Nathan C. Johnson, concrete consulting engineer, New York, whose series of articles on microscopical examinations of concrete appeared in the Engineering Record in the early part of this year, is an important addition, as is also the Stormer viscosimeter, a measuring device for the viscosity of liquids. This latter instrument is especially recommended for testing road oils.



REVOLVING GASOLINE SHOVEL HAS TAPERED HOISTING DRUM



MECHANISM OF SHOVEL ASSEMBLED AT SHOP, ENGINE AT LEFT